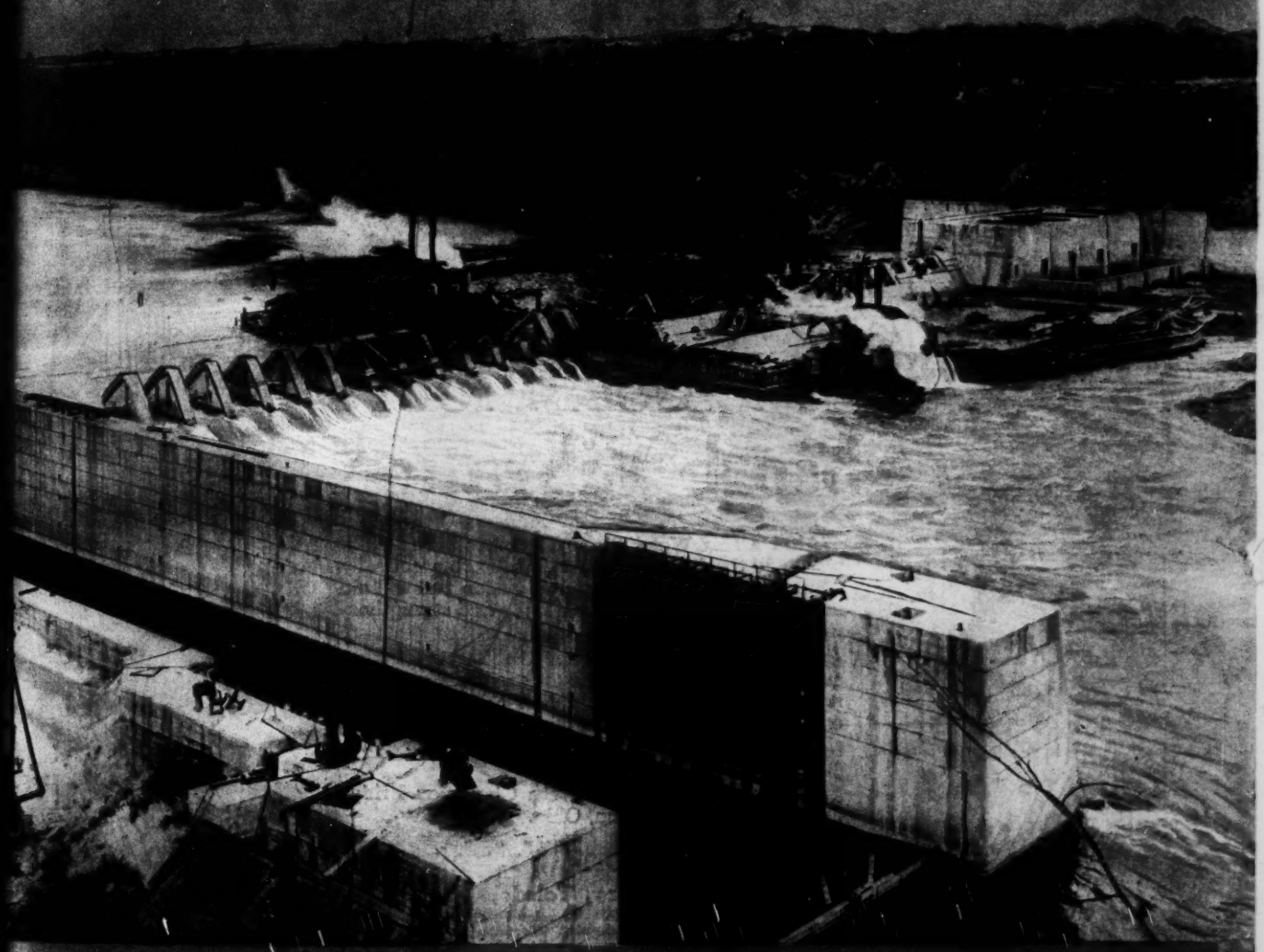
Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL PUBLISHING COMPANY, Inc.
OCTOBER 4, 1917

OCT 6 1917
UNIV. OF MICH. LIBRARY



By a new lock and dam, the head of navigation on the Mississippi River has been moved up 13 miles. Construction was a protracted struggle against unusual and prolonged floods.

Cover released by courtesy of MacArthur Concrete Pile and Foundation Co., New York City

Kreolite Hex

WOOD BLOCK FLOORS *Best for Bridges*

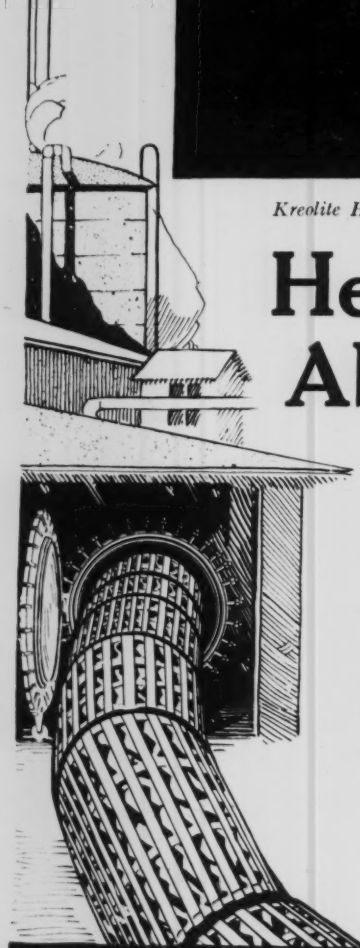
Kreolite Hex Wood Block Floor on Salomonie River Bridge at Warren, Ind.

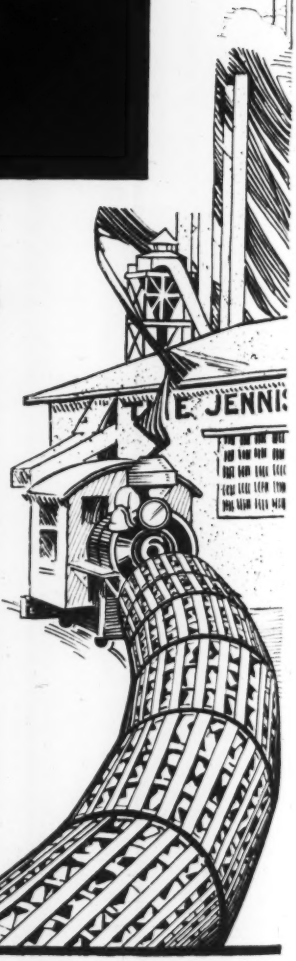
Hex Block Floors Absorb Vibration

After a Hex Wood Block Floor has been laid in place and the filler applied, it will absorb practically 80 per cent. of the shock and vibration and will aid in equally distributing traffic loads and strengthening the bridge.

Hex Blocks are cut from the hearts of slow growing tamarack, and the expansion being radial it is absorbed by one side of the Hex being cut one-quarter of an inch short, thus doing away with all buckling and destructive thrust on the felloe guards.

This bridge was built by the Champion Bridge Company, of Wilmington, Ohio.





The Jennison-Wright Co.

2479 Broadway, Toledo, Ohio

New York Philadelphia Cleveland Cincinnati
Chicago St. Louis Toronto

A Consolidation of Engineering News and Engineering Record. Published by McGraw-Hill Publishing Company, Inc.

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Volume 79 NEW YORK, THURSDAY, OCTOBER 4, 1917 Number 14

Road Builders!

The National Army Needs You—*Now!*

Engineering News-Record has been called upon by the Commanding Officer of the Twenty-Third Engineers, National Army, to mobilize the road-building engineers and contractors of the country in a Nation-wide drive to secure experienced men for the new highway construction regiment of 10,500 volunteers, now being formed for immediate service in the war zone of France.

In the new regiment no pick and shovel men are wanted; the heavy manual labor will be done by German prisoners and service battalions. Recruits must be experienced in some line of road construction, or mechanics skilled in operating road-building plant. A limited clerical staff also is needed. Further details will be found in the official statement on the following page.

Everybody Can Help

(1) If you are qualified by experience for active service fill in and mail the blank form on the next page.

(2) If not qualified for enlistment get at least one man to volunteer. You can be of immense help in this way even if you yourself are too old to serve.

(3) Get this announcement printed in your local newspapers. *This is exceedingly important.*

(4) Have your local engineering society form a recruiting committee. Call a special meeting to get action at once.

(5) *State and city officials*—Carry the recruiting campaign to contractors who are doing your work.

(6) *Contractors* — See that a few men of your organization respond to this call.

(7) Use this page as a poster in your office, or ask us for reprints.

Load Must Be Distributed

Every contractor can contribute a *few* men without disrupting his organization. Do your share. Show that the nation's engineers and contractors, who opened the eyes of the world by the record-breaking construction of the Army cantonments, can also man this new highway unit with the pick of the construction men of America.

If every one puts his shoulder to the whee the volunteers needed will be secured over night, *and no single job or organization will suffer.*

Mature Men Needed as Bosses

For men under 40 with the proper road-building experience, the prospect for promotion to non-commissioned and special ranks is excellent. Practically all construction men, who have the ability will be assigned, *not as Laborers, but as Bosses of gangs, which will include German prisoners.*

Men of Draft Age Acceptable

Even if within the draft age limits you can volunteer for the highway regiment if you have not already been called by your local board.

You can *not* volunteer if you have been called in the draft, or exempted.

You must be in good physical condition.

Your Opportunity

Here is your opportunity to help the Country along the lines of your specialty. We know that the Nation will not call upon its Road Builders in vain.

Read on the following page the official message from Colonel E. N. Johnston, commanding the 23rd Engineers, to readers of Engineering News-Record.

Experienced Highway Construction Men
for Service in France

[THIS STATEMENT IS AUTHORIZED BY COLONEL JOHNSTON, COMMANDING THE 23RD ENGINEERS]

Men who have had experience in any branch of road construction are offered an opportunity to see early service in France in special road-building battalions of the United States Army by recruiting plans here announced. These battalions will be required to repair and maintain the highways near the fighting front, over which tremendous traffic is operated continuously. They will also build new strategic highways in the war zone. Consequently, these troops, all volunteers, will be in the thick of the greatest activities.

The new battalions are constituted as regular military units and as a part of the regular army organization. They are fully armed and will be required in emergencies to fight along with other troops. Generally, however, they will be occupied with road work.

The battalions will form a part of the 23rd Regiment of Engineers of the new National Army. This regiment will eventually have a strength of about 10,500 men—more than an ordinary brigade—and will, so far as is at present known, be the largest in the army. It will be commanded by Col. E. N. Johnston of the Corps of Engineers, U. S. A.

Many Worth-While Jobs

There will be more highly-paid and high-ranking non-commissioned officers in the regiment, it is believed, than in any other. There will, therefore, be more openings for men of education and practical experience than is usually the case.

The organization of the battalions is as nearly the same as that of large contracting forces as is feasible. Modern road-building machinery has been fully provided, including rock-crushing plants, steam shovels, road rollers, tractors, graders, motor trucks and pumps. A full line of dump wagons, wheel and drag scrapers and similar dirt-moving equipment also will be available. Shops for the repair and maintenance of all the plant and equipment will be operated close to the front.

Much of the plant used on road work in America is new to European engineers, while the methods also are quite different from those used abroad. A great opportunity is thus offered to demonstrate what skilled Americans can do with modern equipment, and the regiment which is now being recruited must include men to operate the necessary construction plant, to man the shops and, as non-commissioned officers, to handle the forces.

Who Can Qualify

For the non-commissioned officer positions men are required who can qualify in private life in the following lines: Superintendents and assistant superintendents of highway, bridge and quarry work, of mechanical plant and of transportation; chief clerks, material men, stock men, timekeepers; foremen for concrete, road, bridge and quarry work; powder men, riggers, carpenters, iron workers, surveyors and draftsmen.

For the enlisted personnel it is desired to secure men skilled and experienced in one or more of the following occupations: Surveyors, draftsmen, clerks, stenographers, axmen, blacksmiths, blacksmiths' helpers, machinists, gas-engine operators and repairers, crusher operators, hand driller, drill runner (air drills), quarrymen, powdermen, masons, teamsters, pile-driver operators, concrete, form, road and bridge men; tractor operators (gasoline), grader operators (blading and elevating graders), bridge carpenters, motor-truck drivers, chauffeurs, cooks, motor-truck and automobile repair men, pipe fitters, electricians, horseshoers, tailors, shoemakers, musicians (bugle, fife or drum), mechanics, telephone operators, steamfitters, tool sharpeners, ditchers, boatmen (builders and caulkers), shovel runners (gasoline), barbers, veterinarians, French interpreters, bituminous road men, iron workers, riggers, general utility men capable of driving automobiles, motor trucks and all types of gasoline-driven machinery.

Any male American citizen between 18 and 40 years of age, and who has not actually been called by a local board in the draft, is eligible for enlistment in these special battalions, if acceptable physically. All men must first enlist as privates, the rate of pay being $33 per month and expenses. Men with the necessary experience may be assigned to special duties and given non-commissioned rank at rates of pay ranging from $40.20 to $96.00 per month and expenses. The latter include, for both privates and non-commissioned officers, food, clothing, medical attendance and transportation. Those who enlist will be eligible immediately for promotion, according to their ability and as openings occur. Men who are specially well qualified and recommended will be given definite promise of advancement to higher grades when their enlistment is authorized.

Officers are Specialists

Colonel Johnston, who will command the regiment, was graduated from the United States Military Academy at West Point at the head of the class of 1901. After service on road and bridge work in the Philippine Islands and river and harbor work in the United States, he served as an instructor at West Point and as an assistant to the Chief of Engineers at Washington.

The first two battalions are commanded by Majors I. C. Moller and Henry H. Stickney. Major Moller received his engineering education in France. He has been engaged exclusively in highway work for the last ten years, and for three years has been chief engineer for an American company doing road work in all parts of the world. In this capacity he has been called upon to act as consulting engineer for the governments of almost every Central and South Amreican republic.

Major Stickney was educated at Clarkson College of Technology, Potsdam, N. Y. Since 1906 he has been engaged on state highway work in New York and on the New York State Barge Canal. He has also had considerable experience as consulting engineer in road and water-supply construction. He is a graduate of the Engineer Officers' Training School at Fort Leavenworth and a member of the New York State National Guard.

Captain F. S. Skinner, regimental adjutant, is a graduate of the United States Military Academy. Thus the regiment will be under the direction of those who have fully demonstrated their ability in highway and construction work.

Full information regarding steps that must be taken to enlist in this regiment may be secured from the Commanding Officer, 23d Engineers, National Army, 1419 F. St., Washington, D. C., by mailing the following information to him.

Fill in This Form, by Typewriter if possible, and Mail Today, to

COMMANDING OFFICER, 23rd ENGINEERS, NATIONAL ARMY,
1419 F Street, Washington, D. C.

(1) Name ..... (2) Address .....

(3) Age .....(4) Nationality.....

(5) Married or single.....(6) Have you been called in the draft?.....

(7) Will you enlist for period of the War?.....(8) State briefly your road-building or other construction experience .....

.....

(9) What machinery can you operate?.....

(10 Your present or a former employer must certify to your qualifications by signing here.....

....

SIGNATURE OF EMPLOYER EMPLOYER'S ADDRESS FOR TELEGRAMS

Congressional Controversy Over Definition of Costs

A CONTROVERSY arose in Washington a short time ago of grave importance to every one furnishing material or executing contracts for the Federal Government. It has been apparent for some months that a marked difference of opinion has been growing concerning what should be considered the true cost of materials or services. Different departments of the Government have not agreed concerning this, as was shown some weeks ago when a standard price for coal approved by one department was peremptorily rejected by another. Inasmuch as a large amount of work is being done for the Government on the basis of cost plus a percentage for profit, or is being done under compulsion by commandeering, the price to be fixed later by the Government, this subject of true cost has suddenly become one affecting the entire country. A large part of our population is now engaged in work for the Government, and the success or failure of those responsible for this work will depend upon whether or not the Government decides to adopt these views of cost which are held by men engaged in successful business.

The surprising feature of this situation is the fact that Congress stated very clearly in Section 302 of the Income Tax Law of Sept. 8, 1916, what the true cost of a manufactured product was. The purpose of Congress at that time was to establish the net income of a manufacturing corporation which should be taxed. Manifestly it would insert in that statement of cost nothing which was questionable, for the larger the cost is fixed under the terms of the law the smaller is the taxable income. The statement has since been written into various cost-plus-percentage Government contracts.

The trouble arises over the subject of interest. In the law it is stated that costs shall include "interest paid within the taxable year on debts or loans contracted to meet the needs of the business and the proceeds of which have been actually used to meet such needs." In the contracts this wording was changed to read: "A reasonable rate of interest on a proper proportion of the investment in plant, facilities, inventory and working capital not owned or provided by the Government." Most large manufacturing companies have an outstanding bonded indebtedness incurred to provide buildings and equipment for carrying on this work. The interest charges on this indebtedness are admitted in the income tax law to be a part of the cost of manufacturing, but certain members of Congress disagree with this view.

The trouble is unquestionably due to the fact that there is not a universally accepted clear, concise statement of what must be considered the true cost of carrying on work. Certain economists insist that costs must include a certain interest on the capital engaged in the work. They hold that if capital is invested in high grade bonds it will earn a certain amount of interest without any supervision by its owners, and consequently it is not until that interest is earned that true profits begin to accrue.

It is clear to those who have followed this recent controversy that both sides are acting in good faith The difference of opinion was bound to arise and now that it has arisen it should be settled immediately. The United States will make many more contracts on a cost-plus-percentage basis, for that system of contracting is far superior to any other for emergency work. The time has come, therefore, when the protection of the Government and fair play to our manufacturers both demand an immediate settlement of this controversial subject. There are certainly enough able men in the departments at Washington and enough of the leading manufacturers of the country in that city, giving their time without charge to the Government for various purposes, to enable the House committee on appropriations to obtain in a few days, from a commission appointed from these authorities, a succinct statement of the elements that must be included in any determination of true cost. If something of this sort is not done at once very serious complications will arise which may cause, through financial difficulties, grave interruptions in services greatly needed at this time.

A Discussion of Water-Works Valuation Well Worth Reading

SELDOM have *Engineering News-Record* or its predecessors had the opportunity to present a more carefully developed discussion of water-works valuation than that by J. W. Ledoux on p. 633 of this issue. The author takes the entirely rational view that the use of the valuation should determine the method employed. He advocates three totally different methods, based respectively on original cost, reproduction cost and market value, for three principal purposes of valuation. All three methods are carefully analyzed by him, and he visualizes his argument by developing the three valuation figures for the same assumed plant. With three methods that have so little in common the closeness of the three totals—$241,170, $276,744 and $244,830—is surprising. It would not always work out thus.

If this journal were to take issue with the author it would be on his use of original cost as the basis for ratemaking. This prevents the utility from sharing in the general prosperity of the community it serves. There is, of course, a vast difference between a railroad in open competition with others, and a water-works plant with a protected monopoly. *Engineering News-Record* has no doubt that the railroad should have the benefit of the so-called unearned increment. But even in the case of the water-works plant there seems good reason for basing rates on reproduction rather than original cost. It is hard to determine whether the plant has been judiciously constructed and operated, and it seems more equitable as well as simpler to consider what the identical plant, including the development of business, would now cost, irrespective of whether the actual investment and development cost were higher or lower.

So many free lances have taken their fling at the valuation problem that it is frequently suggested that the only way to keep a clear mind on the subject is to disregard every new discussion that comes out. This does not apply at all to the author's paper. Quarrel though we may with parts of his reasoning, he has given us a most thoughtful and clear discussion of water-works valuation, and all in any way interested in the subject are urged to read the article carefully.

St. Paul-Minneapolis Dam and Locks Are Now Completed

Head of Navigation on the Mississippi Moved Up Thirteen Miles—End of Three-Year Battle Against Floods—First Work Altered To Make 15,000 Horsepower Available

THE NEW Mississippi River lock at St. Paul and Minneapolis was opened for traffic on July 3, 1917, and the head of navigation extended from St. Paul to Washington Ave., Minneapolis, a distance of 13 miles. After one lock and dam of the original scheme (requiring two locks and dams) had been completed (May, 1907), the project was modified to permit developing water-power. Both power and navigation works have original features of unusual interest. Since the new construction was started heavy floods and very cold weather have conspired to interfere.

The original government project for improving the Mississippi between St. Paul and Minneapolis, adopted

FIG. 1. TWO LOCKS AND DAMS RAISE THE HEAD OF NAVIGATION THIRTEEN MILES

in 1894, provided two locks and timber crib dams of approximately 13½ ft. lift each and 2.88 miles apart. (See Fig. 1.) Lock and dam 2 (the upper works) were completed and in operation by May, 1907, giving navigation between St. Paul and Minneapolis at least two months in the year. Lock 1 was completed in 1909, but no work was done on the dam. At that time it was decided to modify the plans to permit developing power.

The plans as now carried out, approved by the River and Harbor Act, June 25, 1910, provided for abandoning lock and dam 2; for remodeling lock 1 for a 30-ft. lift by increasing its height and cross-section, demolishing its floor and building another one 5 ft. lower; for constructing a hollow dam 568 ft. long, of a modified Ambursen type, with eight sluice gates, each 6 ft. square, at the power-house side, and a power-house foundation 112 x 160 ft., and for installing either horizontal or vertical turbines to develop 15,000 hp. (see *Engineering News*, Nov. 12, 1914).

Fig. 2 shows the cross-section of the modified lock and the new position of the floor. The lock floor was a solid underdrained slab 3½ ft. thick, reinforced with 1-in. square rods every 6 in. transversely and every 3 ft. longitudinally. When the demolition of the lock floor, which was 80 x 325 ft. and 3½ ft. thick, was decided upon, a test of its strength was made so that the engineers might check their calculations. This was done by raising the head of water under the floor. A failure at 15.7 ft. head occurred under the lower miter sill; the original computations gave the ultimate load as corresponding to 14.5 ft. (For a description of the test by Adolph F. Meyer, Consulting Engineer at that time in Government service, see the *Journal* of the Association of Engineering Societies, 1913.)

To remove the floor, holes were drilled 1½ ft. apart in lines across the locks at 3-ft. spacing. The holes were sunk to a depth of 3 ft. with a steam drill. Light explosive charges broke the floor into sizes which could be handled by the cableway. One ½-lb. stick of 40% dynamite was used near the walls and two ½-lb. sticks near the center. The center was exploded first and those near the wall last. The reinforcement was cut by oxy-acetylene gas. The cost of removing this floor, about 5000 cu.yd., was $2.62 per cubic yard.

The dam consists of 36 buttresses faced with pre-molded reinforced-concrete beams weighing 5 tons each. There are 19 of these beams on the upstream side and eight on the downstream face. The roll or crown was cast in place with expansion joints at every other buttress. The beams were handled by carrying loops, embedded in the concrete, so placed that when suspended from the cableway they swung into position without twisting. Thin wood fillers were placed at their ends and the anchor loops were wound with oakum to provide for beam expansion. The beams are 15 ft. 3 in. long, and the 9 in. between them was filled with grout.

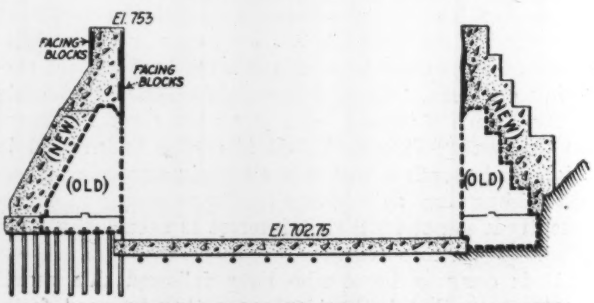


FIG. 2. ORIGINAL WALLS WERE RAISED AND MADE THICKER

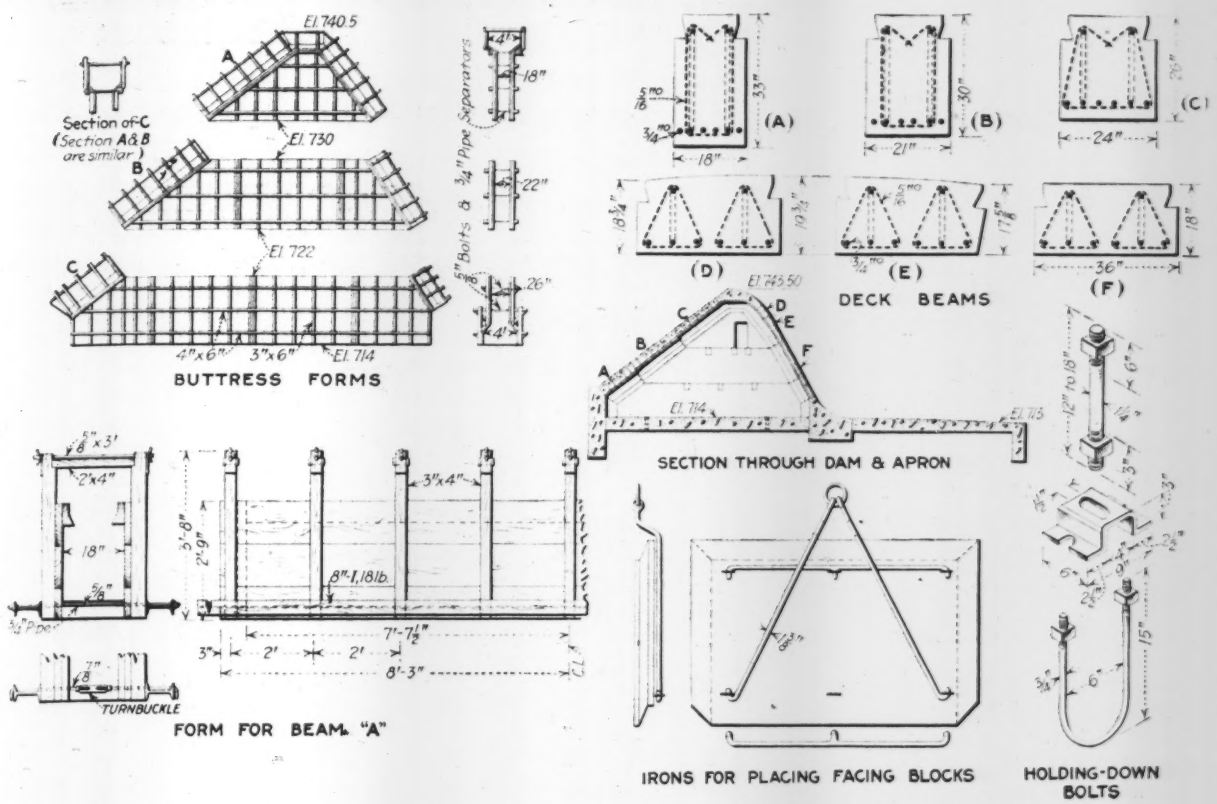


FIG. 3. SOME CONSTRUCTION DETAILS OF THE MINNEAPOLIS-ST. PAUL LOCK AND DAM NO. 1

The beams were cast in wooden forms on the lock floor. Common building paper was used on the bottom to prevent sticking. The side forms and ends were held in position at the top by bolts dropped into slots in the upright form posts and by 8-in. I-beams at the bottom, one on each side—their ends being engaged by hooks on the ends of two rods in a turnbuckle. This is shown in Fig. 3.

The original lock wall had to be increased in height and thickness. Instead of using timber forms and building up in monolith, reinforced-concrete facing blocks with interlocking edges were cast separately in concrete molds and, when cured, were set in place, tied into steel rods in concrete deposited previously, and used as forms for casting the interior of the wall. These blocks were 4 ft. high, alternating 6 ft. and 3 ft. in length and 6 in. and 9 in. in thickness. The short thick blocks were recessed to take the beveled tongues of the larger ones. Hook eyes were cast in the blocks; and a carrier iron with two hooks passed behind an iron bar dropped into the upper eyes and engaged the lower ones, so that the blocks were swung vertically into position.

After lining up bracing and tying, the spaces between the block ends were filled with grout and the joints in the face were pointed later. A bond was made between the facing block and the mass concrete by running $\frac{3}{4}$-in. steel rods through the hook-eyes and bending them to form a single loop with arms extended. Figured as forms alone, these facing blocks cost $1.22 per cubic yard of concrete in place.

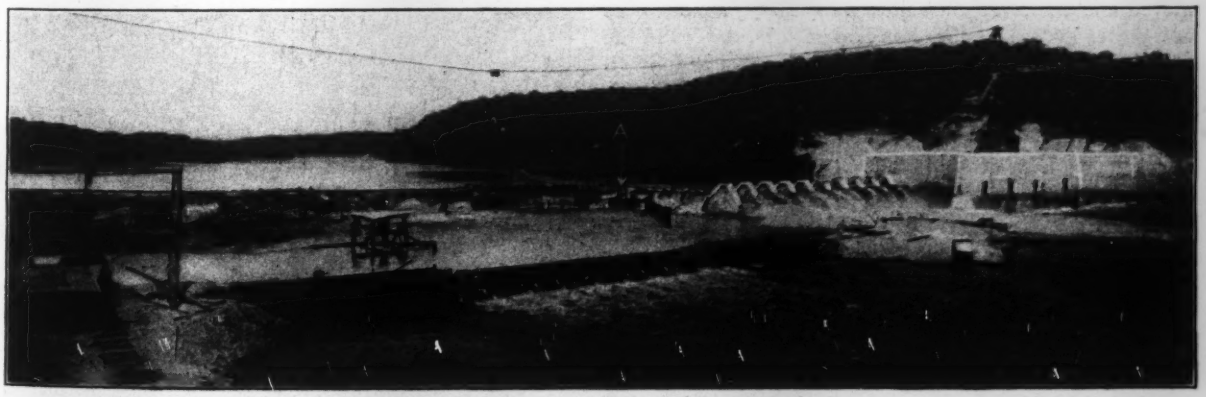


FIG. 4. BEFORE THE FLOOD TROUBLE BEGAN

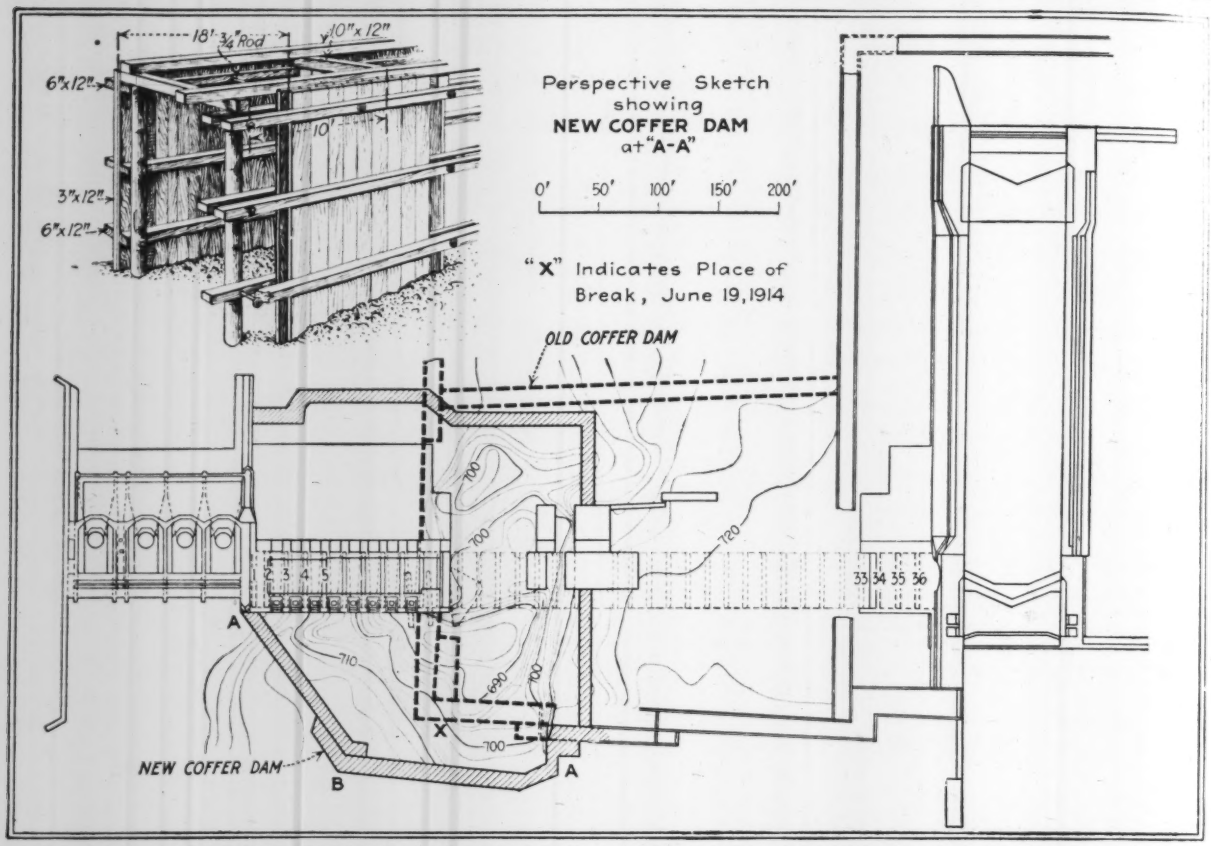


FIG. 5. SHOWING WORK AT LOCK AND DAM NO. 1 BEFORE AND AFTER FLOOD OF JUNE 29, 1914

The crushed stone for all of this work was taken from a limestone quarry developed on the west bank of the river above the lock. All material was handled to the work by a traveling overhead cableway. The wheel pits and power-house foundations were poured from a tower and chute.

On June 29, 1914, lock 1 as modified was completed and the lower gates were hung; the power-house foundation was practically completed; 48 ft. of the dam adjoining the lock and 144 ft. (nine sections) adjoining the power house, including eight sluices and their valves, was built, and the beams on the lower side over the sluiceways were laid to El. 730 (the elevation of the top of the dam being 743.5, Cairo datum). The cofferdam around the power house and sluiceways had been removed and the river allowed to flow through the sluices and power house; a cofferdam had been built around the remaining portion of the dam and some work done on the floor of the site. The river was flowing 30,000 sec.-ft. as against a low-water flow of 4000 sec.-ft., and for several weeks had been flowing over the cofferdam, which had an elevation of 734. On this day the water reached El. 736.8 and a break occurred in the upper cofferdam on the powerhouse side (at "A" in Fig. 4) and the entire lower cofferdam went out (see Fig. 5). Three sections of the dam, including two sluiceways, were undermined and tipped upstream, one section disappearing entirely.

The flood subsided about July 20. It was then decided to allow the river to continue to flow through the break and build a temporary cofferdam to inclose 270 ft. of the dam on the west side. The material deposited by the high water had to be removed, and an attempt made to do this with a suction dredge proved unsuccessful. The removal was accomplished by using drag scrapers, and the temporary cofferdam was completed.

FIG. 6. THREE SECTIONS OF THE DAM WERE UNDERMINED IN 1914

During the fall and winter of 1914-15 the foundation sections 19 to 36, inclusive, together with the breast wall and apron, were completed and a steel sheet-piling cut-off wall was driven along the upper side of the dam its entire length. The plan was to remove the cofferdam around these completed foundations and allow the water to flow over them in the high stages while the remaining gap was being closed.

In March, 1915, work was started on the cofferdam to inclose this gap. The sluiceway sections were included in the inclosure in order that their foundations could be examined and the undermined sections disposed of (see Figs. 5 and 6).

This work was completed, "A" to "A" (Fig. 5) except filling 120 ft. when operations were halted by high water which did not recede until August, 1915. The unfilled portion of the coffer had gone out, and the opening, about 120 ft., had a depth of from 15 to 18 ft.,

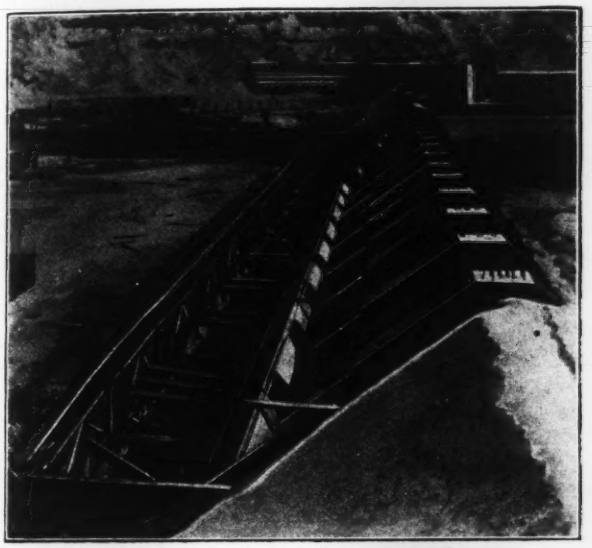


FIG. 7. THE DECK IS BUILT UP OF PRECAST BEAMS AND A CAST-IN CROWN

carrying practically the entire flow of the river with a very swift current.

Thousands of tons of rock were then dumped into the washout at each side of the gap, "A" to "A," Fig. 5, to narrow it and retard the current sufficiently to permit the use of a floating piledriver behind this barrier. By working both ways from "A," and dumping rock on each side of the coffer as it was filled, the gap was finally closed at "B."

By special orders the board of engineers at this time (1915) made an examination of the work, and it decided to complete the dam and apron by resting it on round piles, at 3-ft. centers under the dam proper and at 4-ft. centers under the apron, and to continue the steel sheet-piling cut-off wall along the upstream face of the dam, driving it as deep as possible. Back water from the Minnesota river drowned the work in March, 1916, and work was discontinued until subsidence of the floods in the Mississippi in August, 1916.

Between August, 1916, and April, 1917, the dam was completed. Again unusual and long continued high water forced the work into the winter months, requiring

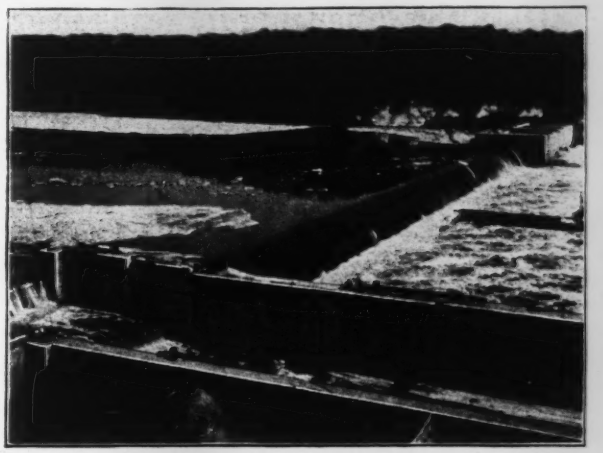


FIG. 8. THE 1917 FLOODS OVERTOPPED THE NEWLY COMPLETED DAM

the heating of the materials used, and forcing unusual hardships on the workmen. During the winter of 1916-17 there were 155 days in which the thermometer registered below freezing, and 53 days in which it registered below zero. On Apr. 5 water flowed over the dam to a height of 5 ft. The roll or crown, parts of which were poured a week before the flood and in freezing weather, withstood the flow of water, ice and logs and came through with only a few scars.

The lower lockgates of the abandoned lock 2 were used for the upper gates at lock 1. These gates weigh 75 tons each and have very recently been transported from the upper to the lower lock and hung. Each gate was swung underneath I-beams attached to a barge and floated down to its new location.

All this work was done by the U. S. Engineer Department under force account. Work on the original dam was begun in 1906 under Col. G. M. C. Derby, and continued under Maj. F. R. Shunk. Work on the new project was begun in 1911 under Maj. F. R. Shunk, continued under Col. C. L. Potter and Maj. E. D. Peak, and completed under Col. E. H. Schulz. George C. Freeman (now major, Engineers' Reserve Corps) has been in charge of the new project on the ground as works superintendent.

Convicts Now Used on Rhode Island Roads

A law recently passed by the Rhode Island Legislature leaves with the Penal and Charitable Commission so much discretion as to the use of convict labor on roads that the result so far has been very encouraging. Convicts can be used only on state roads, but the State Board of Public Roads, having made satisfactory arrangements with the Penal and Charitable Commission, sends a request for a certain number of convicts for work on designated roads direct to the prison authorities who are authorized to detail as many of these men for the purpose as they may consider advisable. The Road Board must carry the cost of transportation, guarding and supervision, and pay a reasonable charge for the labor. Money so accumulated, to the extent that it is in excess of the cost of keeping the prisoners, may be paid to the convicts themselves at the end of their terms, or to their families.

Highway Financing in Texas in Need of Reform

County Road Improvement Procedure Is Flagrant Example of Extravagant Methods of Paying for Work

By R. L. Morrison

Professor of Highway Engineering, Agricultural and Mechanical College of Texas

MILLIONS of dollars in "anticipation warrants" have been issued in Texas to pay for road construction—in fact, several million dollars are probably raised in this way every year. These warrants are issued by the County Commissioners at their own pleasure and without legal limit. They usually bear a high rate of interest, sometimes over 6%, and they are often sold at a discount of 15% or more. Competitive bids are not required, so that the work is often let to favored contractors at absurdly high prices. Very often the work is done without engineering supervision and under a contract prepared by the contractor.

Any county which obtains more than 50 cents worth of road for each dollar expended under this system is fortunate. But perhaps the worst phase of this situation is that no additional tax can be levied to pay the interest on the warrants or to redeem them at maturity, so the regular road tax must be used for this purpose, leaving little or nothing with which to maintain the roads. I understand that at least one county has issued so many warrants that it takes practically all of the road funds to pay the interest on warrants, leaving nothing with which to redeem the warrants or to maintain the roads. It is hard to imagine county finances in a much more "frenzied" condition than that.

The various counties and road districts in Texas issue altogether about ten million dollars' worth of road bonds each year. Probably not less than 80% of this bond money is used for the construction of gravel, shell, and sand-clay roads. Of course, a large part is spent for grading and concrete bridges and culverts, which may be considered permanent, but considerably more than half is spent for the more or less temporary surfacing.

Unfortunately there are very few counties which have anything approaching an adequate maintenance system, and hundreds of miles of surfaced roads are apparently never touched after they are first built. As a result some of the roads go to pieces in a year or two, and there are probably few roads which do not need complete resurfacing within five or six years.

Long-Term Bonds—Short-Lived Pavements

But are the bonds retired by the time this extensive resurfacing is required? Hardly! Data are at hand regarding the term of years of approximately half the road bonds issued in Texas previous to Jan. 1, 1914 (Office of Public Roads Bulletin No. 136). Nearly 60% are straight 40-year bonds and 85% mature in from 20 to 40 years. In other words, it is the old story of paying interest on bonds long after the roads have worn out and been rebuilt.

As a specific instance, one county has outstanding road bonds to the amount of $1,479,000 and anticipation warrants to the amount of $531,559, making a total of $2,010,559. Most of this money was used in building shell and gravel roads, a large part of later issues being used to repair roads built by means of the earlier issues. This county has just voted an additional bond issue of $1,100,000, and according to press reports all but $100,000 of this money is to be used in putting a bituminous surface treatment on the gravel and shell roads under a five-year guarantee.

Statistics regarding other counties are not at hand, but the example given is by no means the worst in the state. This county has spent enormous sums on maintenance while many counties have allowed their roads, built with long-term bonds, to be absolutely ruined in a few years.

Fault Lies in State Laws

The main fault lies not with the individual counties so much as with the state laws, which provide that road bonds "shall run not less than 20 years nor more than 40 years with such option of redemption as may be fixed by the Commissioners' Court," . . . and the court is required "to levy and collect . . . taxes to pay the interest upon such bonds and provide a sinking fund for the redemption thereof, . . ." Of course, the temptation under this law is to issue straight 40-year sinking fund bonds, and so keep the tax rate a minimum. It is a well known fact that to the average man the size of the tax rate is the most important consideration, and this is very likely responsible to a large extent for our unwise and even profligate financing methods.

There is one redeeming feature about these very lax methods of financing which is often overlooked. When a well settled community in the older states improves its roads it gets comparatively little for its money except the roads, so that unwise financing means a dead loss. In the average Texas county, however, the construction of a system of improved roads results in developing the county, increasing the population, raising the property values, etc. This development outlives the bonds even though the bonds outlive the roads, and, while that is no excuse for bad financing methods, it at least offers a little consolation in a bad situation.

Fort Wayne Garbage Disposal Will Cost City Nothing

Under a ten-year contract with the Fort Wayne Rendering Co., approved Aug. 29, the City of Fort Wayne, Ind., will have its "garbage, junk, waste paper, tin cans, waste material and animal stock" disposed of without cost, and will receive $1500 at the outset to buy additional collection equipment. The contractor must collect dead animals, or kill and collect live animals, wherever they may be in either case, on notification by the city, and must also maintain a pound. Material other than dead animals must be delivered by the city to the works of the company. The contractor is required to give a bond for $10,000 for the faithful performance of this contract, and for any failure to accept or receive the various wastes he is liable to a forfeit of $1 a ton. The city has the option of buying the plant at the end of the contract, or at a time for forfeiture for non-fulfilment, the price to be determined by appraisal. The plant is already in use.

Purposes Should Govern Water-Works Valuations

Original Cost, Reproduction Cost Less Depreciation and Market Value Are All Thought To Have Their Applications

By J. W. Ledoux
Chief Engineer, American Pipe & Construction Co., Philadelphia.

After years of discussion of valuation of public utilities, such as a water-works property, there is still no unanimity of view, so that each case has to be treated on its merits by the valuator, with a fair chance that the court or commission will discredit the whole argument. The writer believes one reason for this chaos is the frequent attempt to find one valuation only, whatever the purpose. In the writer's estimation there should be several materially different valuations, depending on the purpose. In particular there are three different bases—original investment, reproduction cost less depreciation, and market value—all of which have their applications in three common cases.

Original Cost for Ratemaking

If rates are to be established, the valuation should be based on the fair and legitimate investment. If the financial transactions have been honest and the works have been built and operated according to average practice, and the book records are in good shape, the historical cost should be taken, and the rates should be such as will enable the utility to receive a fair return on its investment from the beginning. Hence, if the utility has not yet received a fair return past losses must be added to the historical cost.

The logical method of procedure is to tabulate for each year a, plant cost; b, operating expenses; c, estimated depreciation; d, gross revenue; e, fair return, and v valuation. Then

$$e = (a + b + c - d)\ p/100$$

and

$$v = a + b + c + e - d$$

where p is the fair return decided upon as a percentage on the investment.

By this process it is seen that if the utility has earned a fair return and no more, $b + c + e = d$ and $v = a$. If it has earned more than a fair return, v will be less than a, and if it has earned less than a fair return v will be more than a.

Under this plan no allowance would be made for accrued depreciation, obsolescence or fluctuation of value of real estate, water rights or other property. Neither would allowance be made for service pipes or street pavements unless their cost were borne by the water company.

Following are some of the reasons why the writer believes this method of determining value should be used for establishing rates, or where the property is being condemned by the municipality: Most water-works systems were established before the advent of state control and regulation of rates. The owners knew there would have to be a development period, but believed the works would eventually pay a sufficient return to make up for early losses. Hence if the city should condemn, the owners should receive the past cost plus a reasonable rate of return on such cost. With proper regulation of rates the public is protected against undue profits to the water company, and the company is protected against loss. Hence, the valuation must be based on investment and not on estimated cost of reproduction at

TABLE I. VALUATION BASED ON ACTUAL COST, INCLUDING A FAIR RETURN OF 8% ON INVESTMENT, AND 1% DEPRECIATION

Year	1 Plant Cost and Improvements from Year to Year	2 Operating Expenses Including Taxes and Insurance but Not Interest or Depreciation	3 Gross Receipts from Operation	4 Total Expenses (1 + 2 + 7*)	5 Total Expenses Minus Receipts (4—3)	6 Fair Return 8%, Plus 1% Depreciation = 9% on Col. 5	7 Valuation of Plant at End of Each Year (5 + 6)
1889	$42,000.00			$42,000.00	$42,000.00		$42,000.00
1890	6,535.40	$2,025.39	$2,249.67	50,560.79	48,311.12	$4,347.99	52,659.11
1891	2,879.92	1,885.36	3,606.66	57,424.39	53,817.73	4,843.59	58,661.32
1892	6,936.30	1,819.99	5,101.43	67,417.61	62,316.16	5,608.43	67,924.63
1893	1,903.61	1,955.96	6,186.59	71,784.20	65,597.61	5,903.78	71,501.39
1894	1,425.85	1,559.92	7,128.58	74,487.16	67,358.58	6,062.26	73,420.84
1895	7,780.83	2,020.84	8,152.77	83,222.51	75,069.74	6,756.27	81,826.01
1896	1,607.65	3,437.83	9,056.45	86,871.49	77,815.04	7,003.35	84,818.39
1897	10,747.41	3,025.36	9,716.35	98,591.16	88,874.81	7,998.73	96,873.54
1898	1,290.32	4,470.75	9,562.28	102,634.61	93,072.33	8,326.50	101,398.83
1899	1,862.82	2,089.35	10,413.49	105,351.00	94,937.51	8,544.37	103,481.88
1900	532.78	3,479.73	10,803.68	107,494.39	96,690.71	8,702.16	105,392.87
1901	2,870.80	4,596.83	12,774.14	112,860.50	100,086.36	9,007.77	109,094.13
1902	3,279.23	4,151.63	11,627.44	116,524.99	104,897.55	9,440.78	114,338.33
1903	2,779.56	5,252.57	13,207.14	122,370.46	109,163.32	9,824.70	118,988.02
1904	4,322.97	6,284.04	14,363.17	129,605.03	115,241.86	10,371.77	125,613.63
1905	1,636.30	5,885.11	14,272.20	133,135.04	118,862.84	10,697.65	129,560.49
1906	7,262.56	6,196.80	16,257.90	143,019.85	126,761.95	11,408.57	138,170.52
1907	26,412.27	8,209.25	17,772.66	172,792.04	155,019.38	13,951.74	168,971.12
1908	217.71	7,330.24	17,903.87	176,519.07	158,615.20	14,275.37	172,890.57
1909	522.41	6,631.18	19,253.54	180,044.16	160,790.62	14,471.15	175,261.77
1910	6,543.13	7,585.01	19,277.86	189,389.91	170,112.05	15,310.08	185,422.13
1911	11,816.56	4,615.73	21,141.01	201,854.42	180,713.41	16,264.21	196,977.62
1912	3,560.60	5,464.42	23,856.75	206,002.64	182,145.89	16,393.13	198,539.02
1913	7,250.51	8,785.21	26,599.76	214,574.74	187,974.98	16,917.75	204,892.73
1914	13,929.53	6,389.78	27,204.29	225,212.04	198,007.75	17,820.70	215,828.45
1915	14,602.90	9,646.46	27,403.57	240,077.81	212,674.24	19,140.68	231,814.92
1916	11,518.71	6,698.41	28,775.06	250,032.04	221,256.98	19,913.13	241,170.11
1917	369.93	2,036.63	1,080.62	243,576.67	242,496.05	5,456.16	247,952.21

* Figures for 7 in Col. 4 are for end of previous year.
(Valuation as of Jan. 1, 1917, by this method, $241,170.11.)

TABLE II. CALCULATION OF GOING VALUE OF PLANT TO BE ACQUIRED

Date	Given Data, Present Plant: Capital Invested to Buy Old Plant	Gross Revenue	Operating Expenses	Interest on Capital	Net Return	Calculated Data, Equivalent Plant: Capital Invested in Plant	Capital Added to Make Up Deficits	Gross Revenue	Operating Expenses	Interest on Capital	Net Return
1917											
Jan. 1	$276,740										
July 1	276,740					$235,265					
Dec. 31	276,740	$29,400	$8,500	$13,837	$7,063	.....	12,945	.....	.....	$5,882	$7,063
1918											
Dec. 31	276,740	30,500	8,700	13,837	7,963	.....	13,733	10,800	4,160	12,410	7,963
1919											
Dec. 31	276,740	31,700	9,000	13,837	8,863	.....	8,400	19,800	6,240	13,097	8,863
1920											
Dec. 31	276,740	32,700	9,300	13,837	9,563	.....	3,990	27,000	7,910	13,517	9,563
1921											
Dec. 31	276,740	33,900	9,500	13,837	10,565	.....	1,820	31,400	8,940	13,717	10,565
1922											
Dec. 31	276,740	35,100	9,800	13,837	11,463	.....	591	34,300	9,620	13,808	11,463
1923											
Dec. 31	276,740	36,100	10,100	13,837	12,163	.....	.....	36,100	10,100	13,837	12,163
							Going value =	$41,479			

Valuation of plant = $235,265 + $41,479 = $276,744

present prices—nor on market value, which cannot be established until the rates have been fixed for a long period in the future.

Where there are difficulties in the way of determining original cost, because of loss of accounts, or mismanagement or extravagance in the construction or operation of the works, the valuator must use his best judgment to supply proper data for a fair valuation.

What shall be taken for p, the percentage of fair return? A water-works is one of the most important and vital elements upon which the health and welfare of a community depends. To be operated well and continuously, its financial success must be certain. Because of a tendency on the part of public service commissions to squeeze down valuations to figures that are a grave menace to this class of property, capital is reluctant to invest in it unless earnings are assured far in excess of the legal rate of interest. Men experienced in water-works management and finances refuse to purchase these properties except on a 9 or 10% basis, and it would therefore seem that for the present at least 8% should be taken as a fair return.

Table I applies the foregoing reasoning and develops the value for rate-making purposes of a typical plant, established in 1889. By this method the valuation as of Jan. 1, 1917, was $241,170.11.

Reproduction Cost for Forced Sales

Next comes the case wherein a municipality desires to acquire the utility. It may have the option of negotiating with the owners, of exercising its right of eminent domain or of building its own plant. Assuming that the municipality prefers not to condemn, it asks the valuator what it can afford to pay for the utility rather than build its own works. The valuator estimates at present prices the cost of construction of an exactly equivalent plant, from which he deducts a proper allowance for accrued depreciation. To the remainder he adds the value of the acquired revenue and obtains a valuation based on the cost of reproduction—usually designated as "the cost of reproduction less depreciation plus going value."

The municipality may or may not be able to prevent the water company from continuing its business when the new municipal plant is completed. If it cannot the going value will be a maximum, as the city can afford to pay the water company a high price rather than be subjected to disastrous competition. If the city can prevent the water company from continuing its business, it is sure to secure all the revenue within a few years after the new works are completed.

To determine what the going value should be for either of these cases, it is necessary to make a comparison of the financial operation of each plant from the present time up to the time when the new plant is receiving the same gross and net revenues as the old plant is then receiving. The annual differences in favor of the old plant reduced to a present-worth basis will be the going value.

Some broad assumptions have to be made—length of time required to build the new plant, annual operating expenses, depreciation, interest and gross revenue for each plant up to the time at which they are equivalent, and the value of money to be used in calculating the present worth. While the calculation is subject to uncertainty, it is likely to reach much nearer the truth than a mere guess.

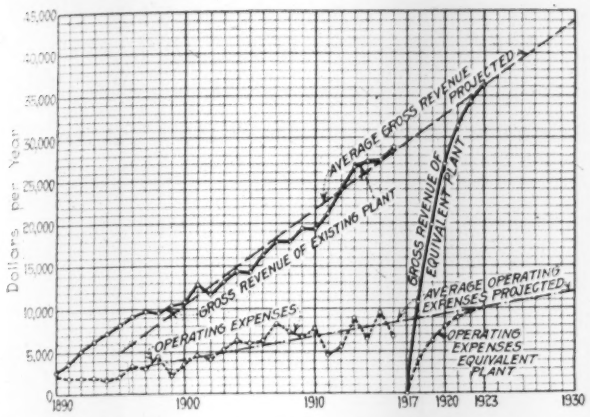
Graphs To Forecast Future

Prognostication of the future is much aided by the graphical method. As shown in the illustration, curves can be drawn to indicate the variation of gross revenue and operating expenses for the old plant, and these can be extended into the future years, preferably by straight lines. From these straight lines an equation of operating expenses is derived in the form $O = a + bR$, in which O is annual operating expenses, R is gross revenue and a and b are constants. Substituting known values of O and R for two points on each of the straight lines, the constant values of a and b are obtained.

The estimated annual gross revenue for the new plant is tabulated and from this an equation may be used to calculate the operating expenses. This gives sufficient data to complete the table. To reduce the net-revenue differences to present worth, it would seem that the rate of interest which the municipality has to pay for money should be used rather than that which the water company should receive as a fair return.

This valuation will represent what the city can afford to pay rather than build its own plant; and it will also show what the water company can afford to ask.

Table II shows the foregoing method of determining going value, based on an assumed price for the existing plant, to be verified afterward, of $276,740 and an as-



FORECAST OF REVENUES AND EXPENSES OF EXISTING AND EQUIVALENT PLANTS FOR DETERMINING GOING VALUE

sumed reproduction cost of $235,265 for the equivalent plant, and gross revenues and operating expenses of both plants as indicated by the diagram, which assumes that six years after the equivalent plant is completed it will have the same earnings and operating expenses as the present plant. It is also assumed that it will take one year to build the equivalent plant.

The left-hand side of the table shows the principal items, including net return, over and above interest on capital, for each of the next six years. With the equivalent plant we assume that $235,265 for construction is borrowed uniformly during the first year, and therefore the interest during the year will be 5% on the total amount for six months. That year there will be no revenues and no operating expenses, and to make up the interest on capital and the net return of the present plant, $12,945 capital must be added. In the next year there will be operating revenues, but the interest will cover the entire year, so that a slightly larger addition to capital will have to be made to make up deficits. Thereafter each year the necessary capital addition will be less, and in the sixth year it will be zero. The going value will be the sum of these additions, or $41,479, and the valuation of the plant will be $235,265 + $41,-479 = $276,744.

Several trial calculations for the going value will, of course, have to be made, and the table worked out from the existing data in each case until we find the sum that will be just sufficient so that at the end of the six years the two plants will be earning the same without any extraction for capital added to make up deficits.

Market Value for Voluntary Sales

The third important case is where the city has neither the right to condemn, grant a new franchise nor build its own works, so long as the water company furnishes good water and service, and where the rates are established for a long and indefinite term of years. If the city or some outsider desires to acquire the plant, what should be the process of valuation?

This is a case where the market value applies. The appraiser is not interested in what it will cost to reproduce the plant, but he is interested in what it will cost to operate and maintain it and make the necessary renewals and improvements. He wants to know how the revenue is varying from year to year and what it is likely to be in the future. His inquiry does not extend beyond thirty or forty years, because he recognizes such remoteness to be in the realms of posterity.

He proceeds to draw graphs of the operating expenses during the past years, and extends them forty years into the future. To find out how the plant is likely to grow he makes a similar graph of the plant cost, which aids him in determining depreciation. With a graph for past and future gross revenue he completes the data from which to tabulate the annual net revenues for the next thirty or forty years. This is preferably divided into two parts, one of which applies to the plant as existing at present. The latter figures are determined by taking the earnings in proportion as the present plant cost is to the future total plant costs. If money in the water-works business is worth 8%, he takes that to reduce the future annual net revenues to present worth, and the sum will be a valuation from which should be deducted the accumulated depreciation up to the present time.

Accumulated depreciation up to the present time must be deducted, for we are starting with a plant that has suffered a certain amount of depreciation. If this be figured from the beginning on a sinking-fund basis, at a fixed per cent. on the cost, we cannot be justified in figuring it in the future at the same rate unless we place the accumulated depreciation up to the present time in a depreciation fund to the credit of the water company—or, what is exactly equivalent, deduct that amount from the price of the plant. Future depreciation, however,

TABLE III. VALUATION BASED ON "MARKET VALUE"

Year	Estimated Cost of Plant at End of Year	Net Returns = Gross Revenue Less Operating Expenses and 1% Depreciation	Net Return on $204,000—Original Plant Cost	Present Worth of These Net Returns on Original Plant Cost at 8%
917	$204,000	$20,730	$20,730	$19,180
1918	204,000	21,560	21,560	18,470
1919	207,300	22,390	22,030	17,490
1920	213,400	23,220	22,190	16,300
1921	219,500	24,050	22,350	15,220
1922	225,600	24,880	22,500	14,180
1923	231,700	25,710	22,640	13,220
1924	237,800	26,540	22,770	12,300
1925	243,900	27,370	22,890	11,450
1926	250,000	28,200	23,010	10,660
1927	256,100	29,030	23,130	9,920
1928	262,200	29,860	23,230	9,220
1929	268,300	30,690	23,330	8,580
1930	274,400	31,520	23,430	7,980
1931	280,500	32,350	23,530	7,420
1932	286,500	33,180	23,620	6,890
1933	292,700	34,010	23,700	6,410
1934	298,800	34,840	23,790	5,960
1935	304,900	35,670	23,860	5,530
1936	311,000	36,500	23,930	5,130
1937	317,100	37,330	24,010	4,770
1938	323,200	38,160	24,080	4,430
1939	329,300	38,990	24,150	4,110
1940	335,400	39,820	24,220	3,820
1941	341,500	40,650	24,280	3,545
1942	347,600	41,480	24,360	3,290
1943	353,700	42,310	24,420	3,060
1944	359,800	43,140	24,470	2,840
1945	365,900	43,970	24,520	2,630
1946	372,000	44,800	24,570	2,440
1947	378,100	45,630	24,620	2,265
1948	384,200	46,460	24,670	2,105
1949	390,300	47,290	24,720	1,950
1950	396,400	48,120	24,760	1,810
1951	402,500	48,950	24,810	1,680
1952	408,600	49,780	24,860	1,555
1953	414,700	50,610	24,900	1,440
1954	420,800	51,440	24,940	1,340
1955	426,900	52,270	24,990	1,240
1956	433,000	53,100	25,030	1,150
				$272,980
Less accrued depreciation				28,150
Required valuation				$244,830

must be figured on the plant cost the same as if no deduction had been made.

Table III shows a calculation for the market value of the property according to this method. At the present time the historical cost of the existing physical plant is assumed to be $204,000 in round numbers—as derived from the first column of Table I. The table shows the gross earnings in the future, both for the present plant and the necessary additions to it for capital account. The last column shows the present worth of these net returns, year by year, and the sum of these, less accrued depreciation, gives the required valuation—in this case $244,830.

In this particular case the valuations by the first and last method are substantially the same, and that by the second is higher. This is not always true. There is, in fact, as will readily be seen, no necessary relation or agreement of the results.

There are still other purposes of valuation, for which the methods to be pursued are not so obvious. Among these may be mentioned valuation for purposes of taxation and valuation for security issues. The three cases cited, however, are the most important ones for which valuations are required.

Summary

Summarizing, there are three fundamentally different methods of valuation, only one of which is applicable to any particular case:

1. *Legitimate Actual Cost*, including deficiencies of net income below a fair return on the legitimate investment. This is applicable to the fixing of rates, and to condemnation of the plant by the municipality.

2. *Estimated Cost of Reproduction Less Depreciation Plus Going Value.* This is applicable to negotiations between the city and the water company, whereby the city desires to know what it can afford to pay for the water company rather than build its own works.

3. *Market Value*—determined from a sufficient number of public sales of the company's stocks and bonds, or, if such records are inadequate, from the present worth of the annual net revenues for the next 30 or 40 years. This is applicable where the rates are fixed for a long and indefinite period in the future and the city has neither right to condemn, build its own works nor grant a franchise to another water company, and where the city or another company desires to purchase. It is also applicable when it is desired to create a mortgage or capital-stock issue, or to determine the valuation for taxation purposes.

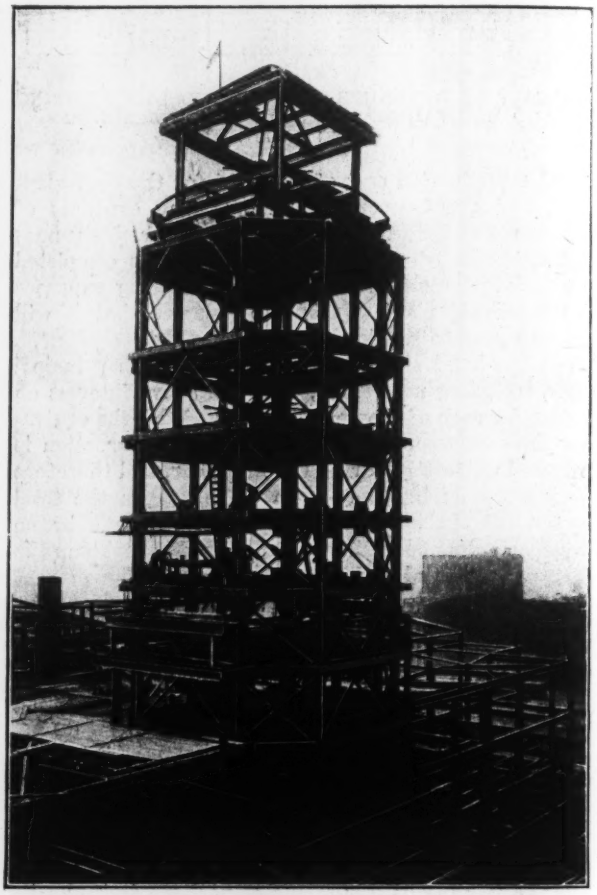
Two Hundred Million Feet of Pine in Army Camps

Since the cantonment construction was started at the beginning of the summer, 250 solid train loads of Southern pine have been delivered to various camp sites from Southern mills, according to the estimate of the Southern Pine Association, which states that approximately 200,000,000 ft. of this wood has gone into camp construction. It is stated that in many instances train loads of lumber have been loaded and dispatched within a few hours after the mill concerned had received the order.

Steel Tower Carries Clock and Water Tank

Freight House Has Unusual Architectural Feature Columns of Upper Portion Offset from Those Below

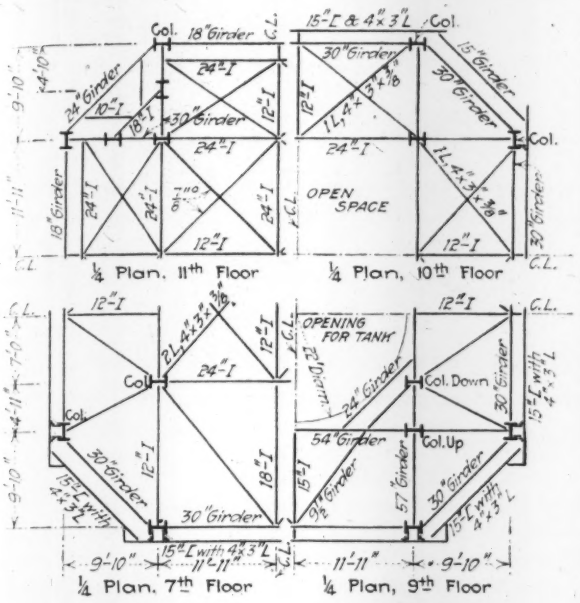
A STEEL-FRAME clock tower, which also houses a fire-service tank, forms a prominent structural and architectural feature of the very large freight station now being built at Chicago for the Pennsylvania



THIS STEEL-FRAME TOWER WILL CARRY A CLOCK AND CONTAIN A FIRE-SERVICE TANK

Lines. This station is a four-story structure 750 x 420 ft., with tracks at the basement level, team driveways on the first floor and three upper floors for warehouse purposes. It is of steel-frame construction with concrete floors, as described in *Engineering News* of Jan. 25, 1917. The exterior finish of the building and tower consists of light-red pressed brick, with green terra-cotta trimmings, and the tower will have a roof of green tile.

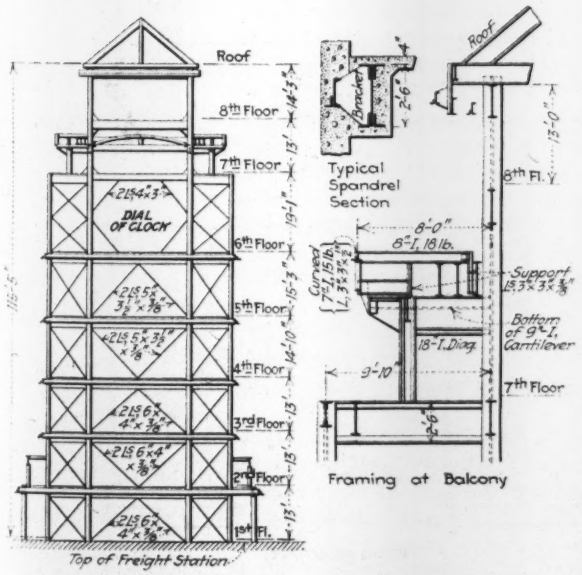
The tower has a height of 126 ft. above the main building, or 190 ft. above the sidewalk. Its height is divided into eight floors. Between the fourth and fifth floors will be a 50,000-gal. tank for the sprinkler service, and above the sixth floor will be the clock, having four 16-ft. dials.



FLOOR PLANS OF STEEL-FRAME TOWER

Up to the seventh floor the tower is octagonal in plan with sides alternately 24 ft. and 12 ft. long. Above this it is 24 ft. square, with a pyramidal roof. The main framing includes eight exterior columns and four interior columns. The former extend only to the seventh floor, where the size of the tower changes. The main interior columns stop at the fifth floor, where heavy girders are framed between these and the outer columns. These girders carry interior columns offset from those below and giving a wider spacing in the upper floors. The seventh floor also has heavy girders carrying short columns which support an outside gallery framing at the eighth floor.

The main columns extend down through the building to the concrete foundations. All the columns are of H-section, each built up of a 14½-in. web plate and four angles, 6 x 4 in., with cover plates over the backs of the angles. Large wing or gusset plates are provided for connections to the floor framing and diagonals. The diagonal bracing is two stories high in the longer sides and one story high in the shorter sides. The clock space (sixth and seventh floors) is higher than the other stories, but the dials prevent the use of diagonals in the longer sides. These large panels, therefore, have only knee braces. This lack of other bracing is compensated for by the use of two tiers of diagonal bracing in the shorter sides.



FRAMING OF STEEL TOWER

The horizontal framing at each level consists of a ring of 29½-in. plate girders between the outer columns, with interior lines of I-beams and girders for the floor. The arrangement of the interior framing varies, owing to the different purposes for which the floors are to be used. The fourth and fifth floors require circular spaces 13 and 22 ft. diameter for the tank, while the sixth floor (on which the clock is mounted) has a rectangular opening about 24 ft. square, spanned by I-beams to support the machinery. Brackets on the outer columns at each floor level, carry a ring of 15-in. I-beams with a bottom shelf angle to support the curtain walls.

The floors have 4½-in. concrete slabs, and all the girders, framing and columns are cased in concrete. The tower is heavily braced to resist an assumed wind load of 20 lb. per sq.ft. in accordance with the requirements of the Chicago building ordinance.

This freight station was designed under the direction of Thomas Rodd, Chief Engineer, and Robert Trimble, Chief Engineer of Maintenance of Way, Pennsylvania Lines. T. M. Bole is Resident Engineer in Charge.

Urges Better State Supervision of Dams

More efficient state supervision of the design and construction of dams is urged in the latest annual report of the Department of Engineering of the State of California. In 1915 the Legislature made it the duty of the department to "pass upon" all plans and specifications for dams, but gave the department no authority to require changes in the plans. To emphasize the fact that safe plans alone will not protect the public, the report states that a wealthy corporation built a dam after designs which the department would have approved. Subsequent interior exploration of the structure showed skimped and faulty work that, according to the report, "endangered the lives of hundreds of people living below the dam."

The report cites two penal provisions of the law governing work done under the direction of the Department of Engineering and urges that these might well be extended to "apply to any owner, contractor or employee engaged in erecting any structure the weakness of which would be a menace to the lives or property of other people." One of these requires any inspector working under the state engineer to render "a full, true and correct report of the kind, manner and progress" of all work upon which he serves as inspector and makes a false report a felony. The other provision makes it a felony for any contractor or his agent or employee knowingly to permit the violation of a contract of such a contractor or to fail to report such a violation.

Ore Dumped to Barges Through Railroad Bridge

Hoppers Are Placed in Bridge at St. Paul and Ore Dumped Directly Into Barges for Mississippi Travel

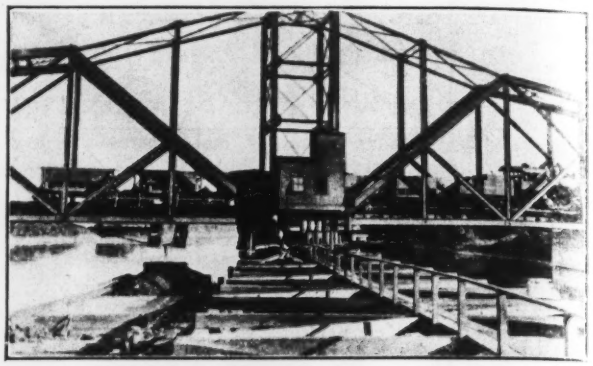
THE city of St. Paul, Minn., recently appropriated $50,000 for municipal ore and coal terminals in the Mississippi, with the idea of facilitating the river transportation of coal from the Illinois district and loading the return barges with ore. On account of the lateness of the season and the difficulties in securing necessary materials the construction of a permanent terminal has been postponed and a temporary coal dock built. This dock cannot handle the return ore, so a unique utilization of an existing railroad bridge as a terminal has been designed and is now under construction.

Coal barges from the south are unloaded in the upper part of the city and will then be dropped downstream about two miles to the St. Paul Terminal Ry. bridge, in the floor of which hoppers will be placed, taking the ore direct from cars run out on the bridge. The openings are to be put just beyond the pier of the swing span of the bridge, the main channel being under the other half of the draw. Piles driven to form a berth will be used to hold the barge in place under the openings while the loading is going on.

The work to be done consists merely in cutting two openings in the open-tie floor and hanging two hoppers from the steelwork of the bridge, according to the details shown in the accompanying drawing.

The hoppers will have a clear opening trackwise at 6 ft. each, with a width of 2 ft. 2 in. narrowing to 2 ft. 6 in. x 2 ft. 2 in. at the bottom. They are hung one on each side of the first floor-beam from the tower. The hopper frames are 6 x 6 x ⅜-in. angles riveted to two 8-in. channels at both top and bottom. The ends of the sawed-off ties will rest on four 12-in. I-beams 7 ft. 4 in. long. Each beam is riveted at one end to the floor-beam of the bridge and the other end is supported by two 12-in. I-beams, 7 ft. 10 in. long bolted to the web of the bridge stringers, which are 3 ft. 6½ in. deep.

The hopper frames are hung from the I-beams by angle plates and bolts. A stiffening frame of 6 x 10-in. and 8 x 10-in. timbers supports the sides of the hoppers about 4 ft. below the base, the rail. The lower 8 x 10-in. timbers rest on the bridge-stringer flanges.



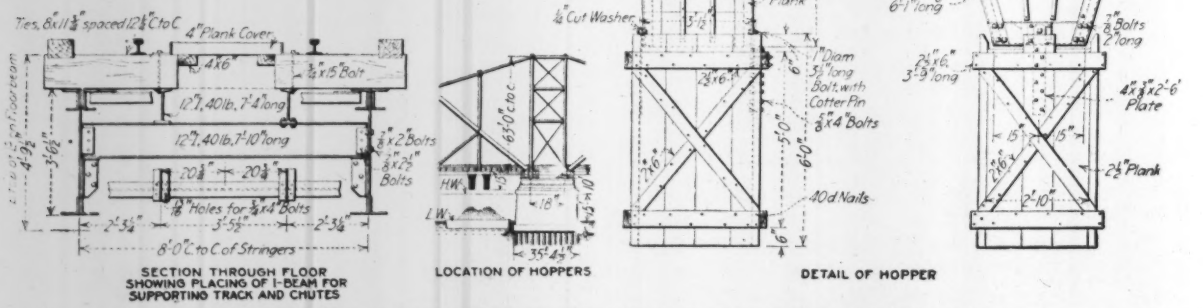
DUMPING ORE THROUGH BRIDGE

The walls of the hoppers are 2½ in. plank lined with sheet steel. The hoppers hang 6 ft. 10 in. from the base of rail and are extended to a length of 13 ft. by swinging timber chutes hung from the bottom of the hoppers by 4 x 2/8-in. plates fastened to the bottom channel of the hopper by a 1-in. bolt and cotter-pin. Two diagonal stringer laterals which cross the openings of the chutes are replaced by stringer laterals from the end of the floor-beam to the stringers.

Plans were made by M. S. Grytbak, Bridge Engineer, under the supervision of O. Claussen, Chief Engineer, City of St. Paul. The construction work is being done by force account. M. N. Goss is Commissioner of Public Works.

Unnecessary Passenger Trains Eliminated

Approximately 20,000,000 miles of train service per year, states the Railroads' War Board, has been saved by the elimination of unnecessary passenger trains.



HOLES ARE CUT IN RAILROAD BRIDGE AND ORE IS DUMPED DIRECT TO BARGE

Pipe Staves Creosoted Without Loss of Strength

Douglas Fir Treated at Low Temperature and Given Crushing Test—Preservative Does Not Taste in Water

By O. P. M. Goss

Consulting Engineer, West Coast Lumbermen's Association, Seattle

THE DECAY of wood staves has come to be recognized as of importance in limiting the life of wood-stave pipe, and methods of creosoting Douglas fir, the pipe material most used, that do not cause loss of strength have been developed by Western lumbermen. The taste of creosote disappears after a few days' service, and there is no ill effect on plant life.

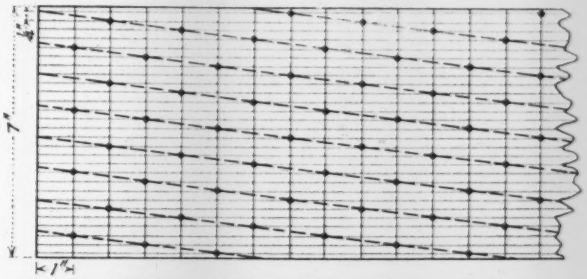
A hydrostatic head of at least 20 ft. has been generally required to keep the staves saturated and prevent decay—and the line is kept above ground where possible. Decay almost invariably starts at the stave ends as the result of leaky joints. Where water runs over the outside of the pipe, algae usually get a start, mosses grow in the soil which collects, and decay spreads. Contrary to old theories, the durability of wood pipe is usually dependent on the life of the wood rather than that of the bands (Bulletin 155, U. S. Department of Agriculture).

Loss of Strength Prevented

During the last three years considerable effort has been made by the engineering department of the West Coast Lumbermen's Association and the Association of Creosoting Companies of the Pacific Coast to improve the methods of creosoting Douglas fir in its various forms. One of the forms already studied is staves. The old methods of treating (boiling or steaming) caused 30%, or more, loss of strength in compression perpendicular to the grain. This loss, of course, was undesirable in the case of staves, which depend on the strength of the wood in side bearing to resist the water pressure. However, by the process of "boiling under vacuum," which greatly reduces the temperature of the oil during treatment, or by simply treating under low temperatures, the loss in strength of the stave has been eliminated.

The West Coast Lumbermen's Association recently completed some strength tests on staves which had been creosoted by this mild-temperature method of treatment. Twelve Douglas-fir staves were selected which were entirely free from sapwood, and twelve other staves were chosen as nearly like the first group as possible except that they contained various amounts of sapwood. All of these staves were 6 ft. long and were kiln-dried. A section one foot long was cut off the end of each stave and retained for control test. The remaining portion of each of the 24 staves was treated in the following manner:

They were warmed in creosote oil for 4 hours at 170° F. and the pressure was raised from zero to approximately 100 lb. per sq.in. until the staves had received about 16 lb. of oil per cubic foot. The oil was then heated from 170° to 230° F. in 3 hours and held at this latter temperature for 1 hour. The staves were then removed.



SMALL PERFORATIONS PERMIT FULL PENETRATION OF OIL

The final heating bath was for the purpose of removing surplus oil and cleaning the staves.

After treatment, as above outlined, the staves were free from excess oil and were easy to handle. They were then placed in a water tank with the untreated pieces above referred to, and all were soaked for about 30 days, after which time both natural and creosoted staves were subjected to a "band-pressure" test.

In this band-pressure test four sizes of bands were used, as shown in the appended tables. Each band was 3.35 in. long and was pressed into the stave the entire length of the band in a direction perpendicular to the grain of the wood, until it was embedded over an area equal to 60° and 90° of the band arc. Figs. 1 and 2 illustrate the method of test used. The loads in pounds required to cause this depth of compression are shown in the tables. Each stave, natural and treated, was subjected to tests of each size band.

The results of these tests show clearly that creosoted staves of all heartwood, as well as those of mixed heartwood and sapwood, uniformly show strength values even greater than those obtained from the test of natural wood. The results are particularly significant since the tests approach about as closely as possible to the actual condition of staves in a pipe line in service. The tests also clearly indicate the practicability of permitting sapwood in staves which are to be creosoted. In the staves tested as above described, the oil penetration in the sapwood was very complete in every case.

Recent experimental work conducted by the writer has also shown the practicability of perforating the outer surface of Douglas-fir staves with small holes systematically spaced as shown in the sketch. The resistance of the oil passing into the wood along the grain is practically nil compared with that found in forcing the oil in across the grain. The fine holes made, through which the depth of penetration and the distribution of oil is controlled, are so small and so regularly spaced that they do not reduce the strength of the wood when tested in compression perpendicular to the grain. The

BAND BEARING TEST ON NATURAL AND CREOSOTED DOUGLAS-FIR STAVE SOAKED IN WATER FOR ONE MONTH

	Load in pounds required to press a section 3.35 in. long of various diameter bands into the stave to a bearing of 60° and 90° of arc								Average for all Tests
	0.193		0.226		0.497		0.625		
	60°	90°	60°	90°	60°	90°	60°	90°	
Staves Containing Sapwood									
Natural	166	371	218	453	507	1,096	608	1,334	594
Treated	171	414	250	518	620	1,338	756	1,663	716
Treated in per cent. of Natural	103.1	111.6	114.7	114.4	122.3	122.1	124.4	124.7	120.5
Staves All Heartwood									
Natural	196	460	267	574	592	1,291	714	1,572	708
Treated	210	531	332	713	752	1,596	880	1,929	868
Treated in per cent. of Natural	107.1	115.5	124.4	124.2	127.0	123.6	123.2	122.7	122.6

result of these perforations is that the depth of penetration and the distribution of the oil can be thoroughly controlled—two factors that are very important in securing the greatest efficiency from creosoted timber.

Effect of Creosote on Water

In connection with the use of creosoted wood-stave pipe, the question naturally arose as to what might be the effect of the creosote oil on the water passing through the pipe when used for domestic consumption or irrigation. There being no data on this subject, the engineering department of the West Coast Lumbermen's Association and the Association of Creosoting Companies of the Pacific Coast coöperated with the Bureau of Industrial Research of the University of Washington in carrying out experiments to determine this effect. The conditions chosen were as similar as possible to that found in the Cedar River pipe line delivering water from Cedar River for the City of Seattle. The test was made on the basis of a 56-in. creosoted wood-stave pipe line 22½ miles long, carrying water at the rate of 5 ft. per sec. The experiment was made to represent in every detail just as far as possible the condition above mentioned. (For full description of the experiment see Bulletin 1, Bureau of Industrial Research, University of Washington, entitled "Creosoted Wood Stave Pipe and Its Effect Upon Water for Domestic and Irrigation Uses.")

Water was collected at various periods after going through the pipe line and was tested both as to its effect upon plant life and also as to whether or not it was affected by the creosote in the staves when used for drinking purposes. A thorough examination of the samples was made by the members of the committee of the bureau's staff, together with representatives of the engineering department of the City of Seattle and the West Coast Lumbermen's Association. At the conclusion of the experiment, the following conclusions were drawn:

After the experimental pipe line had been in service for 13 days, no taste of creosote could be detected in a sample of the water diluted with two parts of ordinary city water.

After the experimental pipe had been in service for 29 days, no taste of creosote could be detected in undiluted water flowing through it.

The amount of creosote that diffuses into water in ordinary creosoted pipes does not have an appreciably injurious effect upon the percentage of germination, the rapidity of growth or the general vigor of the plant.

Further Test of Creosote Action

One of the largest projects built of creosoted staves to date is that of the Wenatchee Reclamation District in the Wenatchee Valley. This line is 8947 ft. long and includes 5675 lin.ft. of 63-in. creosoted pipe, 2470 of 60-in. creosoted pipe and 802 of 44-in. untreated pipe. Water is carried at the rate of 2.31 ft. per sec. in the 63-in. section and 2.55 ft. per sec. in the 60-in. section. It was constructed during the past winter and water was first admitted Apr. 16, 1917.

This line was also tested by the University of Washington, Bureau of Industrial Research, in order to determine the effect of the creosoted staves upon the water flowing through the pipe. Samples of water were collected after passing through the line. The line, being approximately 1.55 miles long, gave a reasonable test, and shows what may be expected from any large pipe line in service.

The finding reported was as follows:

The water had been running through the pipe for eleven days when these samples were taken. The most critical examination failed to show the presence of any foreign taste in the water resulting from the use of creosoted wood staves in the construction of the pipe line.

From the foregoing it will be seen that it appears to be entirely feasible to use creosoted staves in a pipe line to deliver water for domestic or for irrigation uses.

Kiln Dry for Best Results

To obtain the best results in creosoting, staves should be thoroughly kiln dried before treatment and should be impregnated with from 6 to 10 lb. of oil per cubic foot of wood. The treatment should be done by the "boiling under vacuum" method in such a way as not to injure the strength of the wood. The creosote oil goes in freely at the end of each stave, thereby protecting amply the part of the stave most subject to decay. Such treatment will add probably $20 per 1000 ft. b.m. to the cost of the staves.

The extra cost of creosoting the staves does not materially increase the cost of the pipe line in place. This is due to the fact that the cost of the steel bands, the excavation, backfilling, engineering, transportation and other items remain constant regardless of whether or not the staves are creosoted. As a matter of fact, the final cost of a continuous stave line in place, if creosoted, will be approximately 20% more than that of an untreated line.

Creosoted pipe is certain to displace untreated pipe for all uses as engineers become more and more familiar with its real possibilities. A thoroughly creosoted wood-stave pipe line should last from 25 to 50 years under normal conditions. If conditions are very adverse, it should last from four to six times as long as an untreated line.

Milwaukee Has Unique Meter Record

Milwaukee is unique among water-works in having no minimum meter charges and no service charges. Consumers pay for their meters. In 1916, according to the annual report of the water-works, 30,258 consumers, or 48.35% of the total, paid less than $3 a year for their water, and 45,874, or 73.3%, paid less than $5 a year. There were 1009 consumers who paid less than 50c. a year for water. About 99% of the services are metered, and 72% of the consumption. Metered water yields 94% of the revenue. The average daily water consumption within the city is 111 gal. per inhabitant, and within and without the city, 118 gal. The cost of supplying water was 1.572c. per 1000 gal. based on total pumpage and ordinary expenses, and 4.556c. if sinking-fund charges, depreciation, taxes and 4% interest on net invested capital are taken into account. The meter rate is 6c. per 1000 gal. within and 8c. outside the city. Yearly rentals of $5 per hydrant and $50 per drinking trough and per bubble fountain are charged.

Plain Concrete in Sea Water Must Be Protected Against Abrasion

Hard Concrete Surface Is a Carbonate Which Is Safe from Sea-Water Attack, but Softer Interior With Lime Hydroxide Present Is Readily Dissolved if Exposed

By RUDOLPH J. WIG and LEWIS R. FERGUSON

Second of Five Articles on the Problem of Sea-Water Concrete, Written as a Result of Long Investigation and Inspection of Practically All the Marine Concrete Structures in the United States.

UNREINFORCED concrete structures are subject to disintegration by the action of sea water irrespective of location. Unmistakable evidences of deterioration have been observed upon structures along all the coasts of the United States as well as those of Canada, Cuba and European countries. As a rule, the failure of a concrete structure in sea water has been explained on the ground that the concrete has been of poor quality. It is a fact that wrong design, poor materials and improper methods of construction will often lead to rapid disintegration, but even the best of concrete will be chemically attacked after the surface has been appreciably abraded. In addition to the chemical disintegration which occurs to both plain and reinforced concrete if abraded, there occurs a quite distinct physical deterioration of reinforced concrete due to the corrosion of the embedded metal. This will be discussed in a subsequent article.

Deterioration of plain concrete may be due to several causes, but the underlying one, which is chemical disintegration, cannot take place unless the original surface of the concrete as molded is first abraded or eroded from mechanical means.

Why Concrete Is Attacked by Sea Water

One of the main constituents of cement is lime. When the green concrete is placed in the forms, the lime of the cement at or near the surface is in a form to combine readily with carbon dioxide in the atmosphere. Thus there is formed at the surface and for a slight depth in the mass, lime carbonate (limestone) which is practically insoluble in sea water. This layer or skin of insoluble material acts as an armor or protection to uncarbonated cement in the interior of the mass. If concrete is deposited in water it is not exposed to the air, but there is sufficient carbon dioxide in the water to carbonate the lime at the surface, and the same result is obtained.

If this is true, why does not the lime of the cement in the interior of the concrete carbonate in a similar manner when exposed, due to accidental abrasion of the surface? The reason is that as cement hydrates over a period of months in the interior of a mass of concrete where not exposed to carbon dioxide, the lime which is freed as the cement ages is changing from the amorphous to the large crystalline form. On account of its relatively slower rate of solution in water than amorphous lime this crystalline form, which is a hydroxide, does not react appreciably with the limited amount of carbon dioxide present. When the sea water comes in contact with the lime in its crystalline form, the lime is dissolved and passes into solution largely as calcium sulphate, the magnesium salts of the sea water being precipitated as magnesium hydroxide, which is practically insoluble. The dissolving of the uncarbonated lime will continue until the cement is completely disintegrated.

Analysis of disintegrated concrete shows the lime content to be very much reduced and the magnesia content increased. When concrete is placed in sea water some magnesium hydroxide is precipitated on the surface. This coating may become very hard in time, and if not abraded act as a further protection to the concrete.

Outer Skin Must Be Protected Against Abrasion

Assuming this explanation to be true—and it is supported by the physical, chemical and microscopic studies which have been made—it is quite evident that if the outer skin can be protected against mechanical abrasion the permanency of the structure is assured against chemical disintegration.

This chemical action, therefore, is not confined to any particular locality, but occurs in the tropics as well as in the cold climates. The action is far more rapid in the latter case, owing largely to the mechanical erosion from frost. Generally in warm waters the action is so retarded, especially if the quality of the concrete is good, that no apprehension should be felt. The disintegration proceeds at a very slow rate where there is no frost or severe mechanical erosion to remove the softened material.

There is a concrete sea wall on the Pacific Coast in a locality where the winter climate is very mild which serves as an excellent example. This wall, shown in Fig. 1, was built about seven years ago. The top of the wall is 18 ft. above mean low water, but one short section was depressed so that car barges can dock.

Some time after the completion of the wall it was found that the depressed section was about 12 in. too high, and a layer of concrete of this thickness was removed, leaving an abraded surface which is covered at half tide. This surface has softened to a depth of ½ in., but the vertical front face of the wall just below the abraded surface is hard and in perfect condition; in

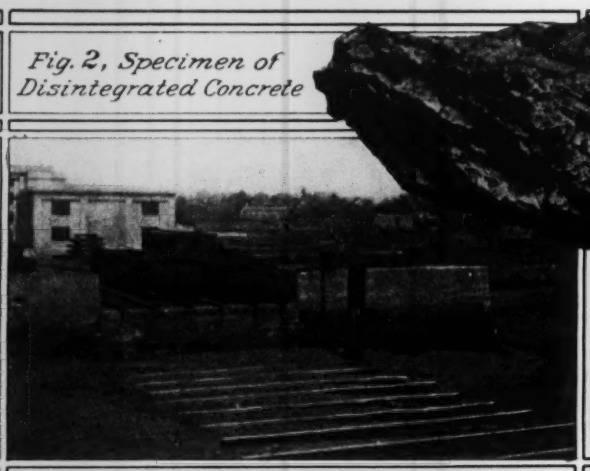


Fig. 2, Specimen of Disintegrated Concrete

Looseness of Aggregate is Apparent

Fig. 1. Abraded Surface Is Softening From Chemical Action of Sea Water

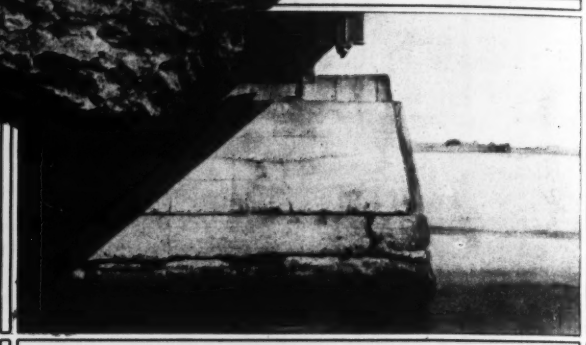


Fig. 3, Erosion Started at Construction Seams Between Successive Days' Work

fact, this surface which was cut away is the only part of the wall which shows any signs of chemical action. As there is very little wave action and no ice in this locality, the disintegration is slow, for the softened material is not rapidly removed, and a fresh surface is not continually exposed.

The characteristic softened and laminated condition due to chemical action was observed in other localities along southern coasts.

Freezing Water Accelerates Decay

In northern latitudes where the concrete surface is abraded by ice in addition to the action of waves, vessels and floating débris, and where the water freezing in the pores removes the decomposed surface so that fresh cement is constantly exposed to sea water, the chemical disintegration is accelerated and proceeds at a rapid rate if the outer skin has been destroyed. When concrete is acted upon chemically by sea water there is a typical lamination and softening of the mortar, so that the coarse aggregate can be removed easily.

Fig. 2 is a photograph of a specimen of disintegrated concrete removed from a sea wall which had been exposed to sea-water action. The loosened aggregate and laminated condition is typical. The mortar becomes like so much soft putty or clay containing grit. As soon as the outer skin is abraded even to a slight depth, the disintegration starts, and it will spread from a softened section under the hard surface skin of the adjoining sound concrete. Where this has occurred the outer layer can be picked off with the fingers, and while the surface which was most exposed is hard and secure, the under side is softened, owing to the disintegration progressing from an adjoining affected section.

It is obvious that if chemical disintegration does not occur unless preceded by mechanical erosion, deterioration will generally be confined to those parts of the structure above the elevation of low water. The concrete below water is practically immune from attack unless it has been placed carelessly, or unless the forms leaked to such an extent that loose stone pockets were formed. In such cases the scouring action of the current may soon undercut the concrete. There are a number of structures which have settled and cracked from this cause.

Concrete bulkhead walls have been built in New York harbor at various periods from 1879 to the present. The construction consists of massive blocks which are entirely submerged. The exposed section of the wall is of granite. In 1912, due to some alteration, several blocks which had been placed in 1902 were removed. The concrete showed no signs of deterioration. Here is excellent evidence that the disintegrating action of sea water does not normally occur below low-water.

Concrete structures which are subjected to sea-water action must usually be built where there is a rising and falling tide. The common practice has been to place the concrete below low water in a cofferdam or by means of a bottom-dump bucket or tremie. The concrete above the elevation of low water is placed in forms which are usually not water tight. When the water drops to the lowest elevation the work of depositing the concrete is started and carried up as fast as possible. Usually the tide rises faster than the concrete can be brought up, and when the water reaches the elevation of the uncompleted section, the placing of concrete is discontinued until the tide falls again below this point. When the water recedes there is always found a layer of soft chalky material covering the top surface of the concrete.

Laitance Comes from Two Sources

This soft material comes from two sources. Part of it is cement, some of which rises to the surface of the concrete when an excessive amount of water has been used in mixing, and part of it is magnesia which has been precipitated from the sea water during submersion. The relative amounts of these constituents and the thickness of the layer are dependent upon a number of factors, such as consistency used, exposure conditions, methods of placing concrete and fineness of cement. If the surface is not thoroughly cleaned of this soft material before the placing of the concrete is resumed, a

seam is formed. Such a condition is seen in Fig. 3. In a very large number of the concrete structures along our coasts these seams exist, and often they are 2 in. or more thick.

This soft layer is particularly susceptible to attack by abrasive action, and as soon as it is removed to even a light depth, the adjoining surfaces of the concrete are exposed to the chemical action of the sea water. As a consequence disintegration very frequently begins at one of these construction seams.

The methods to be used to insure the stability of unreinforced concrete in sea water are dependent upon local conditions, but there are a number of principles of general application which should be followed. The design of the structure should be such that it will as far as possible offer the least opportunity for abrasion or erosion. Sharp corners and edges should be avoided, for these chip easily. An example of poor design from this standpoint is shown in Fig. 4. A pier structure with successive arches is defective in that a large surface is unnecessarily exposed to abrasion and chemical attack where most vulnerable. This could be obviated by either raising the arch so that the springing line would be above high water, or lowering it so that the soffit at crown would be below low water. If neither is possible some other design should be employed. An adequate fender system which would prevent floating material getting under the arch would aid greatly in preserving the structure if the design is used.

The toe of the wall shown in Fig. 5 has sloughed off at the edges, and the concrete has softened. The abrasion at this point was followed by chemical disintegration, which in turn made the softened concrete more easily abraded. Much of this would have been avoided if the exposed edges had been rounded.

The sea wall shown in Fig. 6 was given special surface treatment which resulted in starting chemical disintegration. In order to give an artistic appearance to this wall the surface was tool dressed. This of course removed the outer skin, and as a result softening of

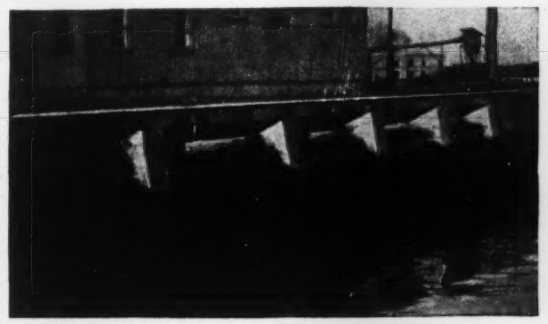


Fig. 4, Exposed Buttresses Increase Possibility of Chipping and Abrasion

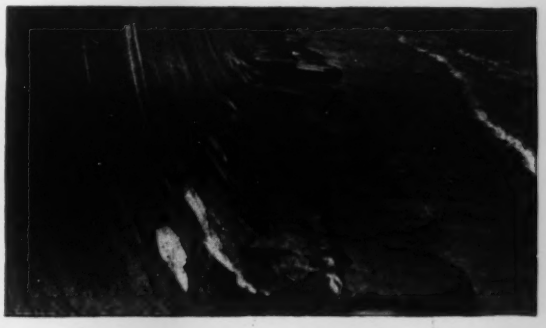


Fig. 5, Toe of Wall Rapidly Disintegrating After Sharp Corner Was Abraded

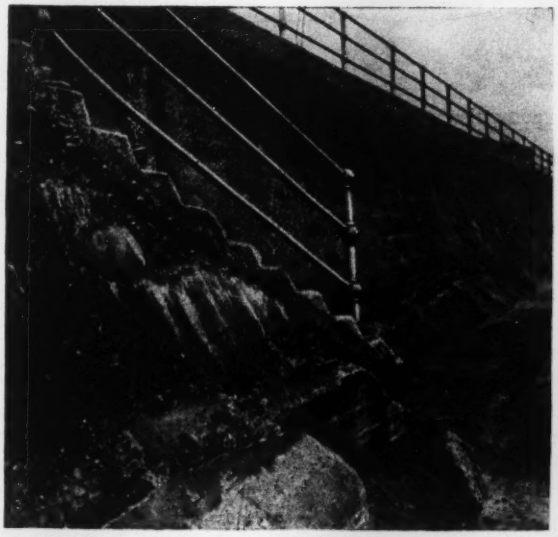


Fig. 6, Surface Tooled Off for Artistic Effect; Rapid Chemical Attack Resulted

Fig. 7, Round Piles are Not Easily Abraded

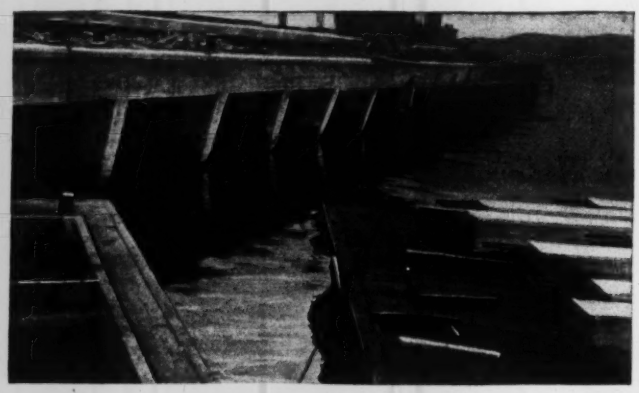


Fig. 8, Square Piles Are Easily Abraded

Fig. 9, Wood Jackets Used To Protect Piles

Fig. 10, Wood Casing Around Pier Prevented Deterioration for Twenty-Five Years

Fig. 11, Granite-Block Facing Offers Complete Protection to Eroded Concrete

the concrete occurred within a very few years after the work was completed. Such practice should be avoided, for the most invulnerable part of the structure is destroyed as far as its resistance to chemical action by sea water is concerned.

The piles used in the wharf shown in Fig. 7 are of excellent design to resist abrasion. The round shape affords less possibility of chipping than any other. Even round piles, however, may be abraded by vessels or floating fender logs rubbing against them.

Ice floating on the surface of the water frequently causes chipping of such piles, and a good example of this was seen under one of the pleasure piers on the New Jersey coast. During a severe winter considerable ice formed, and the waves and current threw it against the piles with sufficient force to cut the surface. The piles were round in this case, which probably minimized the action. Where the outer skin was removed, the concrete beneath softened. A jacket of metal or creosoted wood covering the piles between high and low water would have afforded excellent protection and prevented the trouble.

There is a concrete sea wall on the middle Atlantic coast which offered an interesting study of the comparative effect of sea water on protected and unprotected sections. This wall extends at an angle into the harbor, and near the outer end is a wooden-pile wharf which covers part of the wall. The piles serve as an excellent fender, preventing any abrasive action on the part of the wall they cover. During the winter months there is considerable ice in this harbor, and the unprotected part of the wall has been deeply cut and the con-

crete disintegrated to such an extent that frequent repairs have been necessary. The protected section has not been injured in the slightest degree.

A Canadian engineer's early appreciation of the need of protecting his concrete wharfs against abrasion from ice saved much future trouble for himself and prevented loss to the owners. The wharf is in a harbor where during the winter months considerable ice forms. Square concrete piles were used, as shown in Fig. 8. After the first winter it was found that the surface of many of the piles was eroded, and where this occurred the cement had softened. Wood jackets were at once placed around the piles. These jackets extended from below the low-water line to the top of the pile, and prevented any further erosion of the concrete. As can be seen from the view shown in Fig. 9, the wood jackets are being frayed, especially at the corners, but these can be easily replaced at comparatively small cost.

PROTECTIVE COVERS PREVENT DESTRUCTION

Well made concrete when properly protected from abrasion will resist the disintegrating action of sea water even in localities where the winters are severe. In 1889 a number of large concrete bridge piers were built along the Bay of Fundy in connection with the construction of the Dominion Atlantic Ry. The tide rises 29 ft. or more and there is a very rapid current. There is not a great deal of ice on the water, as no fresh-water tributaries of consequence empty into the bay near these structures. What ice and floating débris there is, however, strikes the piers with considerable force. The engineer who built these piers felt that it would be wise to protect the concrete from abrasion, especially those in the most exposed position. He used wood sheathing held in place with iron hoops. In 1914 an examination was made of these piers. The wood sheathing was completely removed from one of the piers and the concrete, as shown in Fig. 10, was found in perfect condition. There were no signs of softening, and the form marks were still visible on the surface.

Along our New England coast the conditions of exposure are very severe. There is heavy wave action in many localities, and concrete sea walls are often called upon to withstand the shock from boulders thrown up by the sea. Frequently marine structures are located near where fresh-water streams empty into the bay. As a consequence large quantities of ice abrade the surface of the concrete, and this, together with the water freezing in the pores, cause rapid deterioration.

Where such rigorous conditions exist it is advisable to protect the concrete with a granite facing if permanency is to be insured. This has been done in a number of instances with successful results. In this locality repairs can usually be made best by this method. The sea wall shown in Fig. 11 was badly undercut after a few years of exposure, and a granite block facing was used to restore it. In this instance the original concrete was of poor quality, for methods of construction were followed which will not give satisfactory results for marine work.

The conditions which concrete structures in sea water are called upon to resist are most severe, and only concrete of the best quality placed with the utmost care should be used. If this is done and the concrete is properly protected by adequate fender systems, a permanent structure can be secured.

To sum up the subject in a few words, well made concrete properly placed, if not subjected to mechanical abrasion or erosion, is permanent in sea water. If the structure is so located that the concrete would under natural conditions be exposed to mechanical abrasion, chemical disintegration can be prevented only by the provision of a fender system or other protecting medium. Disintegration by chemical action will be very slow unless there is frost action or appreciable mechanical abrasion continually to remove the decomposed cement products as they are formed.

Rock-Cut Roadway on Mountain Side Built Above Railway Tracks

HAMILTON County, Tennessee, of which Chattanooga is the county seat, is engaged in a piece of roadbuilding similar in many respects to the famous Hudson River Road around Storm King Mountain, New York. The Tennessee road girdles Lookout Mountain and will greatly facilitate traffic from Chattanooga to the Wauhatchie valley, which now passes over the mountain on grades as steep as 13%. The new road, with a maximum grade of 5%, is located directly over the Southern Railway tunnel through the nose of the mountain and above the tracks of the Nashville, Chattanooga & St. Louis Railway.

The sides of the mountain, hard limestone and very steep, had to be cut without interference or danger to traffic on the tracks of the N., C. & St. L. Ry. below. An unusual method of rock cutting was followed at the most hazardous places. A channel 4-ft. wide was driven along the face of the cliff on the inside line of the roadway cut. All subsequent blasting was done so as to throw the débris inward instead of outward and down the mountain. The fragments of stone were dragged out of the heading by mule teams on a narrow-gage railway.

This method of cutting left the slope of the cut unusually smooth and true to line, and the work was accomplished as intended without interruption to the railway traffic. The contract price for the work was 80 cents per cubic yard. What it actually cost is uncertain. The original contractor, the McIsaac-Ryan Company, abandoned the job and the contract is being completed by Smallwood & Thompson, of Chattanooga and Nashville, Tenn. The county engineer is L. B. Bryan.

British Town Planning Progress

Town planning schemes totalling 138 in number and 242,230 acres in area have been submitted to the Local Government Board of England and Wales under the Housing and Town Planning Act of 1909, according to the 1916-17 report of the board. The number of communities involved is 89. Procedure under the act is slow at best. "In only ten of the cases in which authority to prepare schemes has been given, since 1911," says the report, "have schemes been submitted for our approval," and of these ten only two (both in Birmingham) had passed through all their stages and been approved.

Richmond Constructs Immense Combined Sewer

More Than Half the City Will Be Served by Reinforced-Concrete Sewer Two Miles Long—Some Heavy Roof Work Required

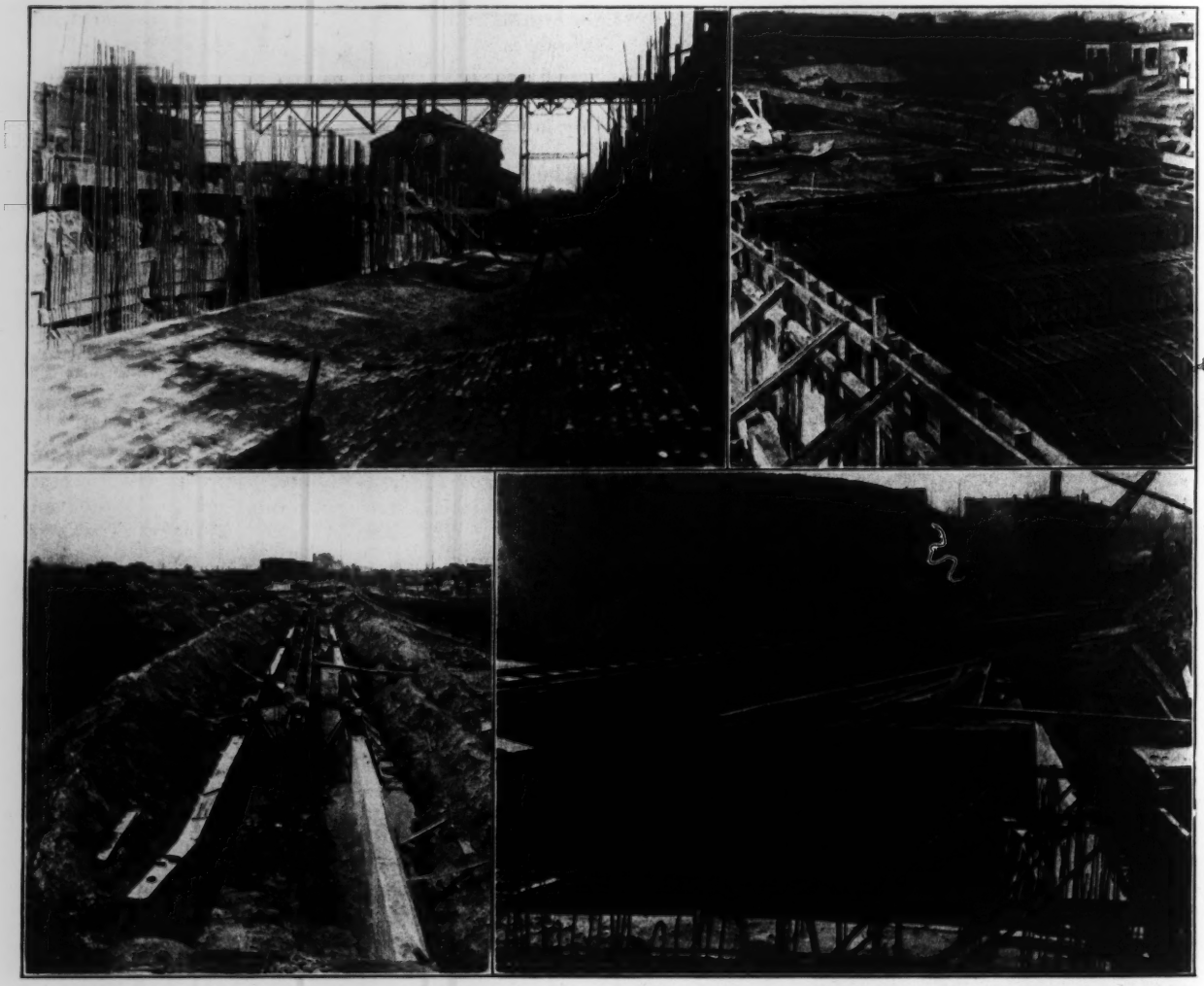
By Charles E. Bolling
City Engineer, Richmond, Va.

A LARGE combined trunk sewer 11,800 ft. long is nearing completion at Richmond, Va. It is of reinforced concrete with an invert lined with vitrified brick in cement mortar. It has a beam-and-slab roof for most of the distance.

The sewer carries the flow of Shockoe Creek, which drains about 12½ square miles or over half the area of the city, and discharges into the James River. About 1¼ miles above its mouth Shockoe Creek is joined by Bacon Quarter Branch. Nearly all the sewers in the territory named discharge into the creek and its tributaries. As nearly all the territory is thickly built up and paved, there is a quick and heavy run-off.

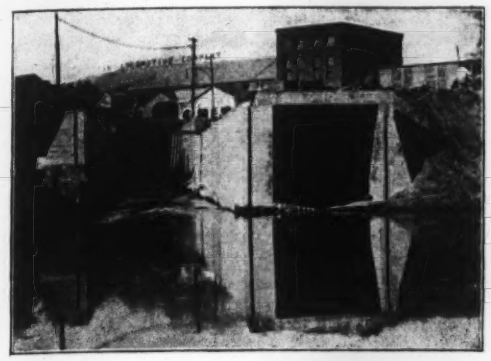
The trunk sewer is 11,800 ft. in length. At its eastern end, for a distance of 900 ft., the sewer is double-barreled. At the upper end of this section a large stream, Cannon Branch, enters. Beyond this point the sewer is 20 x 10½ ft. for a distance of 6600 ft., 18 x 10 ft. for 1500 ft., 9 x 18 ft. and 10 x 16 ft. for 2800 ft. The latter section will not be covered yet.

The natural earth is a hard, blue infusorial clay, so the sewer requires no artificial foundation. Under the main sewer, 8- and 12-in. terra cotta subdrains were laid, and provisions made for side seepage along the entire line. At intervals manholes were installed, with perforated cast-iron caps for ventilation.



BUILDING THE SHOCKOE CREEK AND BACON BRANCH IMPROVEMENT SEWER AT RICHMOND, VA.

1. Concrete invert paved with vitrified brick; reinforcing rods ready for sidewalls. 2. Reinforcing rods in place for concrete slab. 3. This portion will not be covered at present. 4. Construction of sewer under main line of Seaboard Air Line Railway



EAST END OF TWIN SEWER

The accompanying drawings and views show the design and method of construction. At several points the main line of the Seaboard Air Line Ry. and its turnouts pass over the sewer, and at these points heavy reinforced-concrete beam construction was installed.

This sewer will result in a greatly improved sanitary condition, besides redeeming a large area of waste land along the valley, formerly overflowed by every freshet, and leaving a large deposit of sewage. Such reclamation also offers building sites for factories and warehouses, with good railroad facilities. At the eastern end of this sewer, where the two streams unite, the American Locomotive Works now has a large plant for locomotive and munition manufacture, and since this sewer has been completed, it has made large additions to its property for future development.

The total appropriations for this work amounted to $610,285, devoted to right-of-way purchase and to construction.

The shutting-in of this stream is one of the greatest benefits brought to Richmond in the long experience of the writer as city engineer. When the creek is inclosed from the present terminus of the sewer to James River, a still larger section of the city will be redeemed.

This work was planned and carried out under the direction and supervision of the writer, with M. O. Hankins, L. L. Bass and W. F. Woodson serving as assistant engineers.

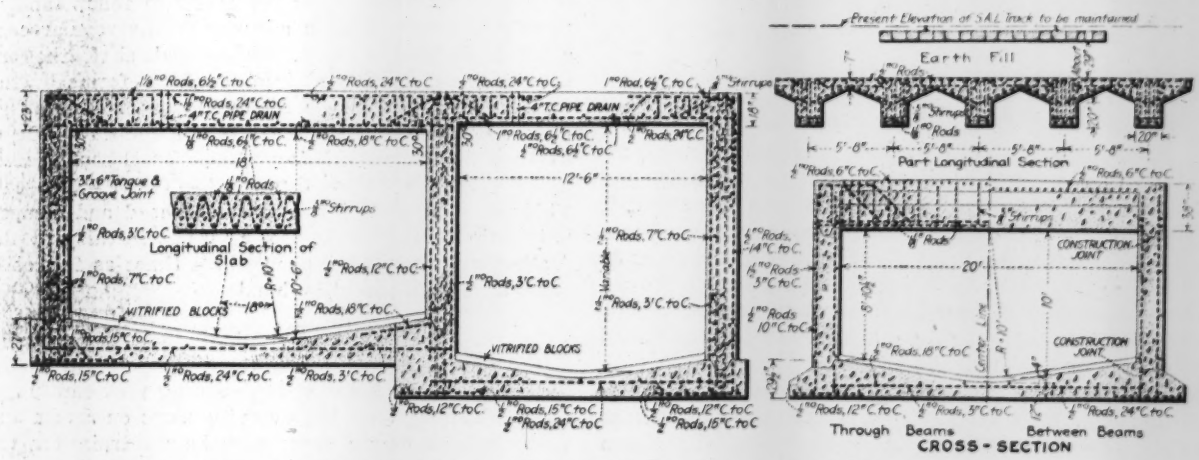
Year Saved by Using Excavated Rock to Line Tunnel

Keeps Up Rapid Progress Begun with Screening and Pneumatic Concrete Plants in Wilson Avenue Tunnel, Chicago

TUNNEL LINING with concrete made from tunnel-run rock and placed by compressed air has resulted in consistently rapid progress in the construction of the Wilson Ave. water-intake tunnel at Chicago. Portable rock screens and pneumatic mixers in the tunnel are used for this work. The tunnel is of notable length, 8 miles, with 3 miles under the lake, and is in solid rock. It is 12 x 12 ft. in section, except for one mile 13 x 13 ft. at the intake end. The tunnel with its construction plant and methods has been described in the *Engineering Record*, Jan. 16 and 23, 1915, and Apr. 29, 1916; and in *Engineering News*, Apr. 22, 1915, and May 25, 1916. The survey work was described in *Engineering News-Record* of July 26, 1917. Since these articles appeared improvements have been made in the methods of concreting the bench walls, and in the organization of the pneumatic mixing and placing gangs.

The work is being done by the city with day labor, with the exception of the crib and about 2000 ft. of tunnel from the crib. The city's work is handled through four construction shafts: at Mayfair (the west end), Lawndale Ave., Lincoln Ave., and the lake shore. These are a little less than 2 miles apart. The heading east from the shore shaft (under the lake) is about 3 miles long, being one of the longest headings ever driven from one shaft.

As the excavated rock is good limestone and of approximately suitable size, it was seen that it would be very advantageous to employ some method by which the rock needed for concrete could be used directly instead of being taken out of the tunnel. No such work had been done in this way before, and considerable study was required for the planning of a plant which would utilize the rock direct from the heading and would not interfere seriously with traffic between the heading and the shaft.



SECTIONS OF TWIN SEWER AND OF SINGLE SEWER WHERE IT PASSES BENEATH SEABOARD AIR LINE RAILWAY

The pneumatic method was adopted, and the plant comprised two traveling outfits mounted on narrow-gage tracks. One carried the pneumatic mixer, with air tanks and a measuring hopper. The other carried a flat screen (with 4½-in. holes) feeding a belt conveyor which delivered the rock to the measuring hopper above the mixer. This latter outfit had an electric hoist for hauling the 1-yd. cars of tunnel rock up an incline to be dumped into the screen.

The rock rejected by the screen fell onto an iron plate on the floor and was shoveled into a car to be hauled out of the tunnel. The entire outfit occupied only one track in the tunnel. The other track was obstructed only by the car for the rejected rock. This car was pushed to the shaft every time a muck train passed through, an empty car being put in its place.

Two Blaw traveling steel forms 30 ft. long were set about 1000 ft. and 500 ft. from the mixer. The 8-in. pipe for conveying the concrete from the mixer to the forms was laid along the side of the tunnel through the first form to the second one, and there it was directed up at 45° into the top of the form. When this form was filled with concrete, the pipe was disconnected and arranged for filling the other form. As the concrete set, the forms were moved alternately toward the mixer, until about 1000 ft. of lining was completed. The mixer was then moved 1000 ft. and the same operations were repeated.

First Pneumatic Outfit Started

The first pneumatic outfit was started working east from the shore shaft in December, 1915. At first a distance of 500 ft. was planned for conveying the concrete but the distance was increased until experience determined about 1000 ft. as the proper maximum distance. The heading at this shaft was about one mile ahead of the mixing plant when the concrete work was started. With two forms, the progress of the concrete work was about 2½ to 3 times the progress of the excavation work. This machine, therefore, caught up with the heading in about six months and was stopped until the heading was further advanced.

The record for the work under the lake is given in the accompanying table. This ends with April, 1917, as since that time both machines have been shut down awaiting further progress in the excavation. Only the upper part of the tunnel section is being excavated at the present time, a bench approximately up to the springing line being left to furnish material for lining the remainder of the tunnel.

In the meantime, the heading from the Lincoln Ave. shaft was holed through so that rock could be hauled from the heading east of the shore shaft to be used for the concreting plant which had been started at the Lincoln Ave. shaft in March, 1916. Accordingly, the concrete gangs from the two machines were organized into one gang with three forms to follow the Lincoln Ave. machine and only one form for the shore-shaft machine. This arrangement made it possible for one gang to operate the two mixers alternately. Then by working three shifts, they were able to fill the three forms at Lincoln Ave. and one form at the shore shaft, keeping the concrete work going constantly on one of the two machines.

As there were four forms in use, there was no delay caused by waiting for the concrete to set or waiting for the forms to be moved. Each shift, the concrete gang found a form moved and the pipe connected up ready to start the concreting. Each gang completed one form and changed the pipe ready to start the next shift. A form-moving gang worked one shift, moving the forms and placing the sand-bag bulkhead at the forward end.

PROGRESS OF LINING WILSON AVENUE LAKE TUNNEL, CHICAGO

(Work Prosecuted from Shore Shaft Only)

Date	Dist. from Shaft, Ft.	Concrete Placed, Cu.Yd.	Date	Dist. from Shaft, Ft.	Concrete Placed, Cu.Yd.
To Feb., 1916*.	1,890	3,396	Nov.	684	1,38[illegible]
Feb.	1,215	2,300	Dec.	432	864
Mar.	1,325	2,508	Total, 1916	9,568	18,72[illegible]
Apr.	895	1,700	1917		
May	1,056	2,006	Jan.	262	524
Aug.†	174	330	Feb.	168	33[illegible]
Sept.	1,185	2,627	Mar.	1,489	2,778
Oct.	712	1,424	Apr.	493	1,10[illegible]

* Record from Dec. 9, 1915 to Feb. 1, 1916.
†Work stopped June 1, 1916, as it had overtaken the heading. Started again August 19.

The machine at Lawndale Ave. was started in April, 1915, and the one at Mayfair shortly afterward. Both of these machines used rock from the heading east of the Lawndale shaft, as the tunnel had been previously holed through between these shafts. One of the new features of placing the concrete at the Lawndale shaft was the use of the pneumatic mixer for placing the concrete in the footing wall. This is a wall about 1 ft. high, used as a guide for the forms to follow, and is usually built by hand in advance of the regular concreting. In placing this at the Lawndale shaft, the concrete was first delivered into the Blaw forms by the pneumatic mixers in the regular manner. But a key plate was left out of the forms, and a chute was placed so that the concrete being placed by the pneumatic method would overflow through the chute into a car. This car then carried the concrete ahead and dumped it into the forms for the footing wall. In this way the footing wall was placed about three times as fast as it could have been placed by hand.

Organization for Concrete Work

The organization required for the operation of the concrete work included 3 men pushing rock cars up to incline, hooking on cable, dumping same on screen and pushing back empty cars to make up train for the heading; 1 man operating motor hoist for pulling cars up incline and for operating belt conveyor; 2 men shoveling rejections from screen into cars to be hauled out of tunnel; 2 men unloading cement and storing it on a platform above the air tanks, adjacent to the mixer hopper; 3 men operating hopper over mixer, feeding cement, water and rock; 1 man operating mixer air valves; and 1 man at end of pipe in concrete form. When there was sufficient rock on hand for continuous concreting, the forms were filled very rapidly, one form having been filled in 100 min. The forms contained from 50 to 70 yd. of concrete, depending upon the overbreak. During January, 1917, one machine at Lincoln Ave. placed 2707 lin.ft. of tunnel lining.

The Wilson Ave. tunnel is the first in which the concrete work was carried on simultaneously with the driving, and using the mine-run rock from the heading for the concrete. The use of the pneumatic method made this possible, and has saved more than a year in

the construction of the tunnel. The pneumatic mixers are patented and are leased to the city by the Concrete Mixing & Placing Co., of Chicago. The construction is being done by day labor under the Department of Public Works. This plan was adopted on the recommendation of John Ericson, city engineer, and the work is being done under his direction. It is in the direct charge of Henry W. Clausen, engineer of water-works construction.

Wet Road Concrete Is Compacted by Transverse Rolling

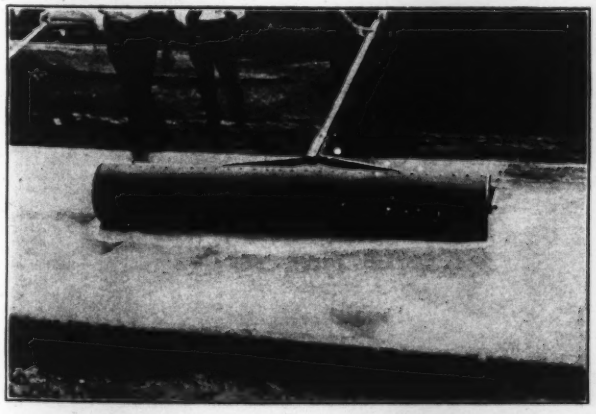
Experiments for Removing Excess of Water from Concrete—Rolling Solves Difficulty and Improves Concrete

By P. C. McArdle

Superintending Engineer of Roads for Vermilion County, Danville, Ill.

THE elimination of the excess of water which it is necessary to use in mixing and placing concrete for roads, and the compacting of the surface, have claimed the attention of all engaged in this class of construction. This applies especially to engineers. Henry W. Bowlby, former state engineer of Oregon, has patented and successfully used a roller shaped to the contour of the road and traveling longitudinally. This is operated by a gas engine running on the side forms. Capt. J. J. Gaillard, city engineer of Macon, Ga., uses a small hand roller. City Engineer Johnston, of Sioux City, Iowa, uses dry sand-cement mortar worked in by hand floats. All of these methods are for the purpose of removing the excess of water from the concrete and compacting the surface. The writer had attempted to obtain the same effect by persistent working with templates, floats, belts, etc.

Repeated laboratory tests made by the writer and others have proved beyond question that excess of water weakens concrete, in proportion to the excess. This is true, particularly in the early periods, in both tensile and compressive strength. There can be little doubt that excess of water leaves concrete porous and tends to produce excessive shrinkage in warm or windy weather. The matter was the frequent subject of discussion between F. Kaufman, of the Portland Cement Association, and the writer. Both sought a remedy, if possible an inexpensive one, that could be tried out on our county bond roads, contracts for which had been let and for which there were no further funds available.



ROLLER REMOVES EXCESS OF WATER AND COMPACTS CONCRETE ON ROAD WORK

Mr. Kaufman agreed to furnish a roller if the writer would agree to find a job on which to experiment with it. The first roller was 9 in. in diameter, 4 ft. long, made of No. 18 galvanized iron with heads of the same material. It weighed 46 lb. This was placed on Division 5 of our county bond roads. The contractor, Prendergast-Clark Construction Company, agreed to give it a trial. So impressed was Mr. Prendergast by the work done by this roller that he would not now be without one. This roller has been in use some two months and has surpassed our expectations. Its success led to our determination to further experiment with sizes and weights till an ideal roller is produced.

Four additional rollers have since been placed. The Granite City Lime & Cement Company has placed one on each of its divisions, Nos. 2 and 7. These are 12 in. in diameter, 4 ft. long, with wood heads. Each weighs 56 lb. P. M. Johnson & Company, on division No. 8, uses a roller 10 in. in diameter, 5 ft. long, weighing 54 lb. John McMahon, on division No. 6, uses one 12 in. in diameter, 5 ft. long, weighing 66 lb. The last four are of No. 20 galvanized iron. It is difficult to determine which of these is the best. All show splendid results, but the roller 12 in. in diameter 4 ft. long seems to be most convenient. The larger sizes are rather unwieldy. One man can readily handle the smaller size.

The immediate effect of the use of these rollers is a marked lessening of the water content, and a forcing down of the coarse aggregate (particularly as applied to crushed stone), leaving a smooth dense surface which is easy to finish. These rollers are popular with engineers, contractors and workmen. All seem to take particular interest in seeing them work successfully. They have prevented almost entirely the haircheckking and wind cracks which ordinarily occur in hot and windy weather. This latter effect alone would justify their use, as all familiar with this class of work can attest. The most valuable effect, however, is that it lessens the cost of finishing and makes a better finish than either the hand float or belt.

The method used on the Vermilion County bond-roads is as follows: Immediately after the template is seesawed across the forms, the roller, fitted with a 10-ft. handle (it may be longer for wider roads) is pushed slowly across the concrete and is pulled back again over the same area. The roller is then lifted forward its own length. Rolling is continued in this way until the template is reached.

After the roller is used the first time, a long-handled float is drawn across the pavement, smoothing the surface. Water rapidly collects on this surface. The use of the roller a second time disposes of this water by pushing it over the side as the roller moves back and forth. After the second rolling the concrete is ready for final finishing with a long-handled float.

If a great excess of water happens to be used, rolling must be continued till the excess disappears. Concrete roads caught in the rain may be refinished readily by using the roller.

Construction Was Speedy at Camp Lewis

Largest of the National Army Cantonments at American Lake, Washington, Accommodating 48,000 Men, Finished in 56 Days

By Nathan A. Bowers
Pacific Coast Editor, "Engineering News-Record"

CAMP LEWIS, at American Lake, Wash., was estimated to be 80 per cent. complete on Sept. 1 and at that time Sept. 4 was set as the date for "practical completion" of the work. As the contractors were given authority to start on July 10 this makes the actual construction period for this camp about 56 days, including Sundays and two holidays. The time for the arrival of the last of the full quota of drafted men having been advanced to about Oct. 1 there was more time for finishing up the work than was at first expected. However, accommodations were ready for the 1400 officers who arrived on Aug. 29.

Perhaps the most distinguishing feature of the work at Camp Lewis has been that at such a distance from Washington and where local conditions govern so many construction features, it was often necessary for those in charge to take responsibility upon themselves. Progress was the goal to which all else was made secondary. Commanding officers and contractors agreed that the policy would be "Do your best to obey orders. If you can't obey orders, do the best you can."

THIS GRAVEL DIKE SEPARATES SPRING FLOW FROM MAIN LAKE, ACTING AS FILTER IF SPRING SHOULD FAIL

When the supply of the kind of sewer pipe required was exhausted the next best was chosen. There are, perhaps, four different kinds of pipe in the main sewers—but a well-built sewer system is ready for service. This was typical throughout. Nothing was permitted to keep back the work. The progress charts which were laid out in advance were scrutinized constantly and wherever a blockade or delay in delivery was threatened, forces were concentrated, other materials or methods were substituted and somehow or other progress was maintained.

Anticipating the possible use of the site as a permanent camp, Lieut.-Col. A. R. Ehrenbeck was assigned in April, 1917, to laying out and making large-scale maps of a portion of the tract. Thus much time was saved when the contract was awarded. Most of the tract is either open country, or forested with large conifers. Very little brush clearing was necessary, and as far as possible the trees in the cantonment proper were left in place. The ground slopes gently and practically no grading was required.

The first work undertaken was the securing of a temporary water supply from driven wells. Four two-stage centrifugal pumps, driven by 100-hp. motors, deliver the permanent supply to camp through two 12-in. mains. Two of these pumps draw from wells and the other two from large springs.

A particularly satisfactory permanent supply was found in these springs because their flow, estimated at about 5.5 sec.-ft., appears at lake level. It was thus possible to build a broad gravel dike separating the cove where the springs occur from the main lake and draw the supply from this cove. If the draft should at any time exceed the capacity of the springs, water would percolate through the dike from the main lake, thus affording a filtered emergency supply.

Sewage flows by gravity without pre-treatment into Puget Sound, 3 miles away. The two legs of the U are served by two main trunk sewers, varying from 10 to 21 in. in diameter. These deliver into a 30-in. outfall which is 3 miles long. In all there are 24 miles of trunks and laterals.

The chief problem in building the sewer system was to find a practicable route for the main outfall which would not necessitate crossing the plant of the du Pont Powder Company. A route to the Sound was finally located which avoided the buildings and stockade of the company. This was deemed absolutely necessary, as it would have been very difficult to guard the powder properties had the sewer gangs been allowed to work directly through the plant.

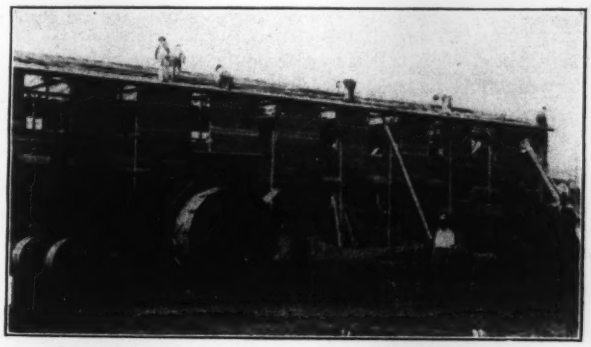
The cantonment is on the Northern Pacific Railway, 17 miles from Tacoma, and a line is being built which will give direct connection with the Milwaukee System. The contour of the ground was so favorable that the main contract was made to include about 9 miles of railroad, 5 miles of which is in a U-shaped line

TEMPORARY PUMP HOUSE AND INTAKE AT LEFT—FOUNDATIONS FOR PERMANENT PUMPS AT RIGHT

THERE WERE 3½ MILES OF 30-INCH SEWER OUTFALL TO BE LAID

reaching all parts of the work. The remaining mileage is in sidings.

This convenient rail system has been an important factor in expediting the work. Congestion has been avoided, and the very minimum haul on all materials is made possible. For example, two saw mills have been used, one on each leg of the U, each with five motor-driven saws. From the convenient sidings it is possible to keep the lumber passing through the saws at



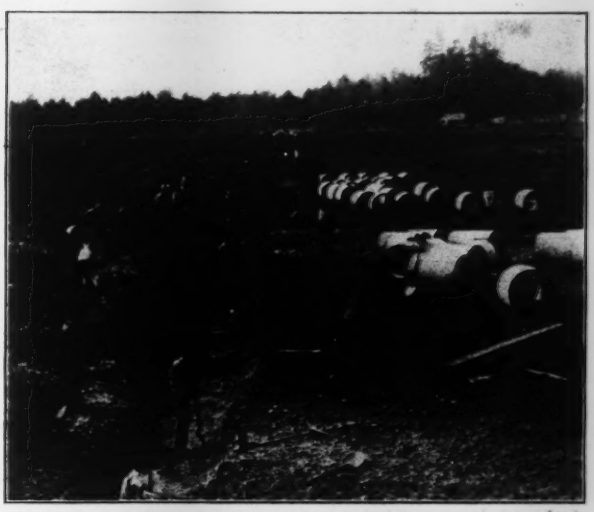
ROAD BUILDING AND BARRACKS CONSTRUCTION PROCEED SIMULTANEOUSLY

the rate of 160,000 ft. b.m. at each saw mill per 8 hours.

From the sidings to various parts of the work the materials are taken by motor trucks. The motor equipment consists of thirty-three 3-ton Kelly-Springfields, seven 2-ton Jeffrey quads, twelve ¾-ton Reos and 57 motorcycles. It was originally planned to quarter 15,000 horses and mules at the camp but work on the stables has been stopped pending decision on a plan to "motorize" the camp and the forces on a broader scale.

A separate contract for the roads was let to the Independent Asphalt Paving Company and about 5 miles of road were built, the type being waterbound macadam with a surface of roadamite, a very heavy asphalt base oil. These roads are 30 to 60 ft. wide. The secondary roads are 24 ft. wide and about 15 miles are being built and graded now. The geological formation underlying the camp is universal, consisting of a gravel bed some 300 ft. in depth. No binding material for the roads was found at the camp, but an energetic search, instituted at once, developed a source of binding material nearby which combines with the gravel very well.

There were one hundred and forty-four 200-man infantry barracks to be built and about 1200 buildings in all. The camp is to accommodate 48,000 men and is about 13 per cent. larger than the cantonment at Louisville, Ky., the next in size. Carpenter work was done first on the buildings which could conveniently



ON SOME SECTIONS PRECAST CONCRETE SEWER PIPE WERE USED IN HAND-EXCAVATED TRENCH

be used by the workmen, and thus from the early stages, workmen who lived at the camp were well housed. At the height of the work the payroll included about 9850 men of whom 6000 lived at the camp. That there has been practically no sickness among the 6000 men is attributed largely to the excellent sanitary measures.

At the outset the contractors kept their own timekeepers on the work, checking up the workmen twice a day, the plan being to punch the time card which the workman usually wore tucked into the band of his hat. This was found to be an unnecessary duplication of the inspection which the government's field auditing system provides for. The contractor therefore gave up the plan entirely and decided to take the time records of the government timekeepers. The contractors' entire timekeeper's force was then taken over by the army officials and directed by them throughout the work. The rate paid common labor was $3 per 8 hours with time-and-a-half for over-time.

In the desire to expedite the work advantage has been taken of every short cut which seemed possible. The plan of building barrack walls on the floor and then raising the side complete was employed here in somewhat the same way as at Camp Upton, as described in *Engineering News-Record* of Aug. 23. The posts in the

17-mile fence around the cantonment were driven by small piledrivers, road scrapers were used for backfilling sewer trenches and motor trucks and electric motors were employed wherever possible.

Construction has been under the direction of Major David L. Stone as constructing quartermaster. Carl F. Pilat served as landscape architect, Charles H. Alden in charge of building construction, and W. J. Roberts in charge of waterworks and sewers. The contract for the entire work, exclusive of road construction, was held by the Hurley-Mason Company of Portland, Seattle and Spokane. The expenditure totaled about $4,000,000.

Builders of Canadian Camps Have Simplified Organization

ACCOMPANYING is a chart, showing the organization of Bate, McMahon & Co., of Ottawa, who have built all of the concentration and training camps in Canada in recent years. All of the work done has been rush work and notable records for speed have been made. It should be remembered (see *Engineering News-Record*, June 28) that the organization is self-contained, has a permanent skeleton and is mobile. Construction equipment, men and supplies are loaded on trains for transporting where needed. The construction camp is under canvas, but trains serve as the base of supplies for three weeks when required.

The managing director of Bate, McMahon & Co. is R. S. Low, commissioned colonel for the military coördination of the camp work. His place in the organization is peculiarly shown on the chart as "Colonel Low's Office," for the reason that in his absence all routine matters are disposed of as usual by his office force.

A second feature is the presence on the staff of a representative of the Militia and Defense Board of Canada or of the Imperial Munitions Board of Great Britain. This officer is virtually a coördinator placed here for the supervision and quick approval of the designing, which is done by Bate, McMahon & Company.

The sloping line to chief engineer, superintendent of construction, etc., indicates the rank of the several members of the staff. There is complete and harmonious informal confidence and coöperation among the members of the staff, although the records of requests and dispositions flow up, across and down through the regular channels.

The chart is so drawn that it shows the forces brought successively into action in the case of a new job. Rail transport arrangements are first taken up; then the purchasing agent's department moves to secure materials and to transport men, and the chief engineer's department opens up the preliminary work which paves the way for the superintendent of "construction"—meaning ground work. By this same time the office forces are transferred and the paymaster and commissary are duly on hand. The sanitary work of course starts before wood construction, and the lighting and power-supply treads on its heels.

Surge Chamber Equalizes Flow of Sewage to Pumps

Collapse of a non-reinforced concrete sewer 10½ ft. in diameter at the sewage-pumping station at East St. Louis, Ill., occurred about two years ago, and it is believed that this was caused in part by the surge resulting from a sudden stopping of the pumps. The sewer had the suction pipes of the pumps connected directly at the side, without screens. There is a gate for closing the outlet to the river when high water requires the sewage to be handled by pumping. After the accident a surge and screen chamber was built, 107 x 30 ft., the width being controlled by the boundary lines of property owned by the city. The height is 14½ ft. The structure is of reinforced concrete, built in quicksand and supported on piles. E. F. Harper is city engineer.

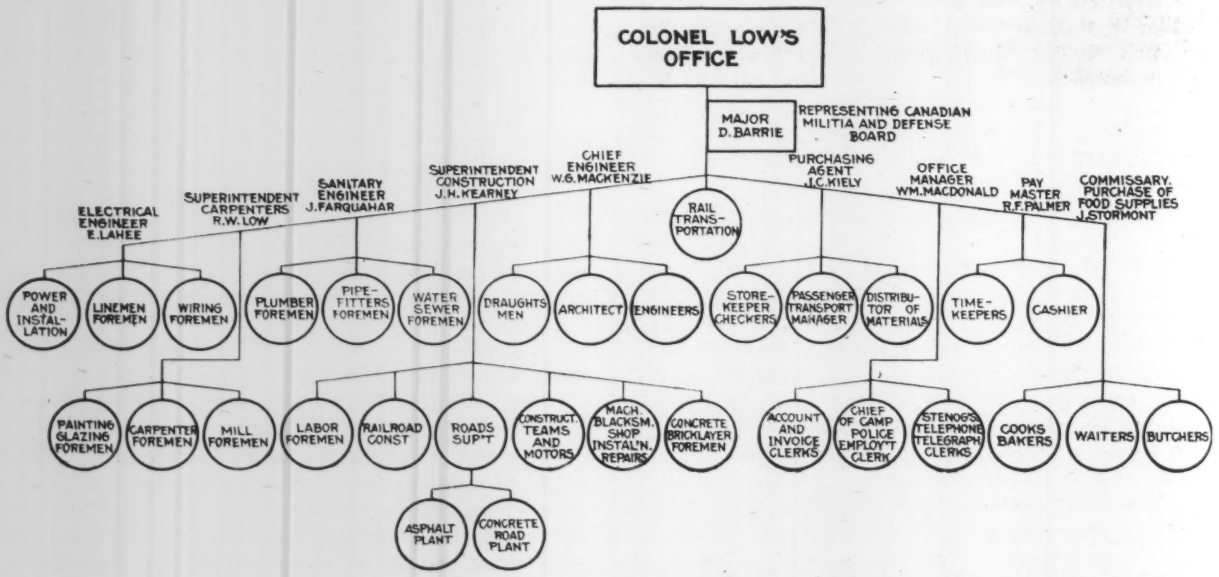


CHART OF CANADIAN CAMP BUILDING ORGANIZATION SHOWS RESPONSIBILITY AND SEQUENCE OF WORK

La Salle's Concrete Causeway Has Become Popular

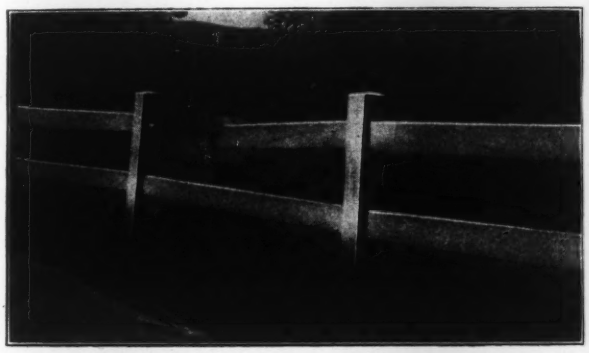
Difficulty of Foreseeing Traffic Development Is Emphasized—Experience with Railing of Reinforced Concrete

By H. K. Higgins
La Salle, Ill.

IMPROVING a causeway at La Salle, Ill., with a concrete pavement has resulted in an increase of traffic which illustrates the difficulty of foreseeing and adequately providing for the vagaries of popular fancy. Municipal engineers are often blamed for lack of foresight in just such cases, when they had no reason to expect what followed and when, had they done so, they could not have secured at the outset an appropriation sufficient to meet later requirements.

La Salle is a mining and commercial city of about 10,000 inhabitants midway between Chicago and Rock Island. It is the happy owner of a concrete-surfaced causeway giving access to the rich farming land south of the city. The causeway is about 20 ft. wide on top, some 10 ft. high above the flat bottom land, about a mile long and has bridges at each end across the Illinois River and a canal. At times the river spreads out over the flats. It has been known to cover the causeway.

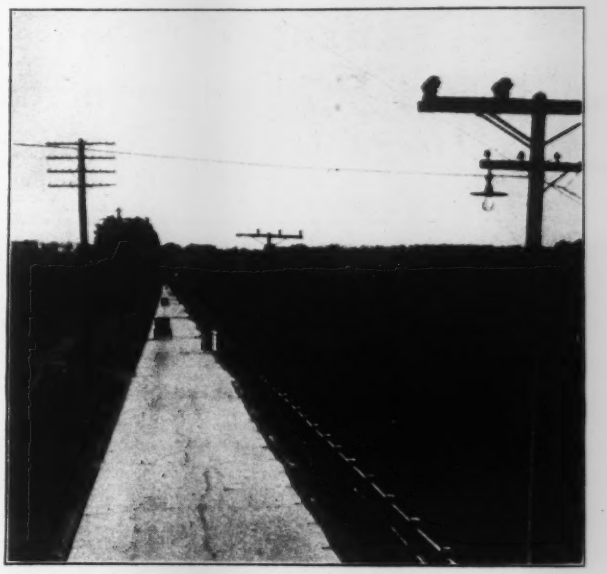
As there is no bridge on the east for some five miles, and none west for a mile or so, its selection for improvement by paving was justified by its importance as a traffic avenue. There are three cement factories within five miles, so the use of concrete as paving material was almost inevitable. The causeway was paved four years ago, and later the concrete paving was extended for several miles south and southeast.



REINFORCED-CONCRETE RAILING WILL NOT WITHSTAND AUTOMOBILE COLLISIONS

The combination of shade, concrete surface, river breeze and accessibility led the public to adopt the causeway as a promenade. The pleasure resorts south of town attract the motorists, and the town attracts the country people, so the net result is a traffic many times greater than the original concrete-road promoter could have anticipated. The road itself is excellent, well laid out, well built, with expansion joints on skew. The surface is excellent, with but few cracks.

The causeway was originally revetted with rock on both sides. It has electric lights on concrete poles and concrete railing between the slopes and paving. Lately some filling has been done on the upstream side with the idea of building a sidewalk for the premenaders, who have thus far shown no signs of growing tired of their adopted boulevard.



POPULAR CONCRETE CAUSEWAY AT LA SALLE

The congested traffic has resulted in frequent collisions (the local saloons do not close on Sunday) both with other vehicles and the railings, thereby calling attention to the difficulty of adapting concrete to the purposes of a railing. The posts are 6 in. square, 6 ft. long, have two mortises 2 x 6 in. at 9 and 27 in. from the top, and are set 30 in. in the ground. They are reinforced with one $\frac{3}{4}$-in. rod at each corner. The rods are held in the mold during concreting by clips of about No. 10 wire. The rails are 2 x 6 in. by 8 ft., slightly tapered at the ends, cast flat, and reinforced with one $\frac{3}{4}$-in. rod bent up and hooked at the ends. Chairs or clips of No. 10 wire were used to keep the rod in place in the mold. Evidently the maker was not satisfied with the lateral strength of the rails, so a 1 x 1 x $\frac{3}{16}$-in. angle bar was introduced at about mid-depth.

The writer believes this to have been an error, as the rod was thereby forced too near the surface of the concrete and a plane of weakness was introduced across the section.

The writer believes that two smaller rods wired to space, and without the angle, would have been stronger laterally and surely would have better resisted corrosion. While the writer finds it necessary to criticize this one item of reinforcement, he considers the work as a whole worthy of high praise.

Civic Association to Meet at St. Louis

The American Civic Association will hold its 13th annual convention at St. Louis, Mo., on Oct. 22-24. City planning and city development will be among the subjects considered, and there is to be a discussion on the subject of the best means of carrying on civic improvement work while the country is at war. The secretary of the association is R. B. Watrous, 914 Union Trust Building, St. Louis, Missouri.

Atlanta Warehouse Plans Were Changed To Increase Storage

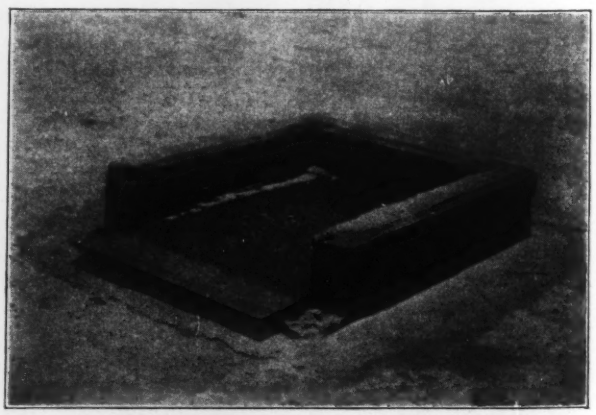
Operation of First Units Leads to Various Modifications in Design in Interests of Economy—Construction, Now Nearly Completed, a Race Between Grading and Concrete Work

FLOOD LIGHTS MOUNTED ON TOWERS MAKE NIGHT WORK EASY

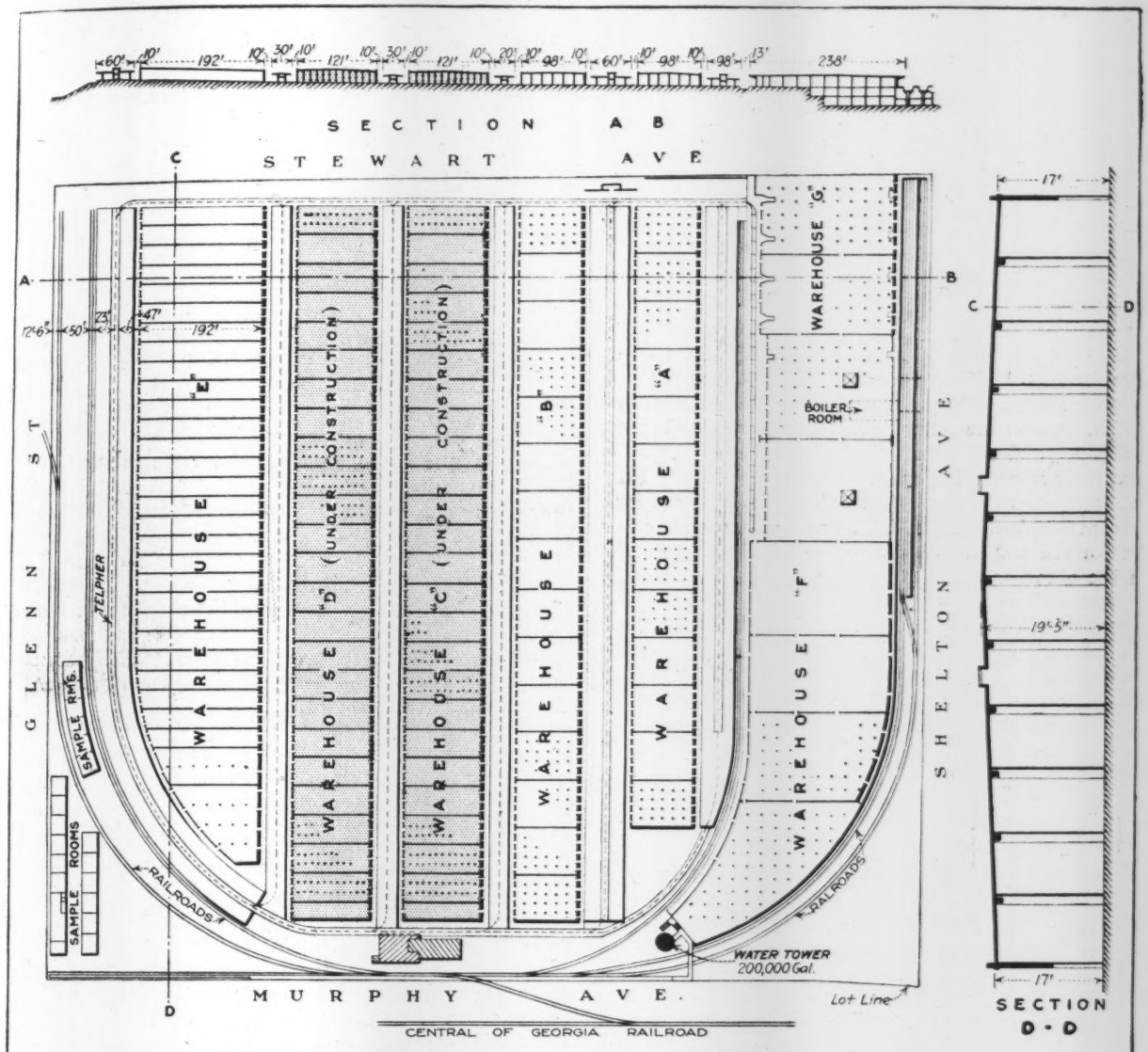
WIDER BUILDINGS and narrower aisles between them for telpher tracks, simpler sheds for the latter, an increased number of columns with greater economy in roof construction, and the replacement of monitors with concrete ventilators are changes made in the interests of economy in the central units of the Atlanta Warehouse plant, now nearing completion. Extensive grading has been required at the site, and in carrying the construction of the two center buildings through from east to west it has been a race to keep the grading work, done with a revolving shovel and teams, ahead of the concrete construction. The latter is carried on with a plant, which has been moved twice, set between the two buildings. This plant mixes concrete at ground level and hoists it to the level of the roof for distribution in buggies.

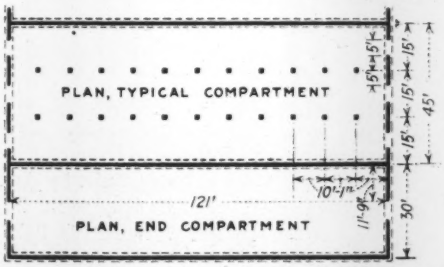
The plant was placed under construction in 1915, and its design was described in *Engineering News*, Dec. 16, 1915, p. 1190. The operation of the first units made it evident that the transfer space between buildings could be narrowed to the limit allowed by insurance standards, and the buildings correspondingly widened with increased storage space. Another economy resulting from this change is a narrower shed over the telpher tracks to protect the cotton handled in and out of the warehouses. The flat-roof construction adopted in the earlier units has been changed to a beam-and-slab design in which the spans are shortened by using more columns, resulting in a 4-in. roof slab with economy in concrete yardage over the 5-in. slab used at first. These changes and the design of the new telpher sheds are shown in the drawings.

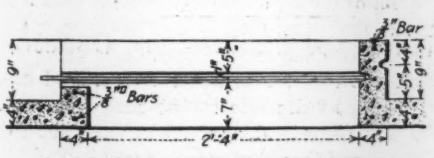
Another feature which quickened and cheapened the construction is the use of concrete ventilators and skylights, cast in one operation with the roof, in place of steel skylights of the monitor type installed on the first buildings. The concrete skylight consists of a small curb around three sides of a square hole in the roof, with a lower curb on the fourth side, away from the ridge of the roof. Above the top of this lower curb around the three high sides of the opening is a slot formed by a wooden strip in which a sheet of wire glass is set in mastic. Between the bottom of this glass and the top of the low curb is a narrow space through which air can pass, but which is protected from the weather by the overhang of the glass sheet. A change has also been made to simplify the door design. Simple sheets of corrugated iron, slightly larger than the door openings, are suspended on rollers from a bar iron track in the same way as on a box-car door.



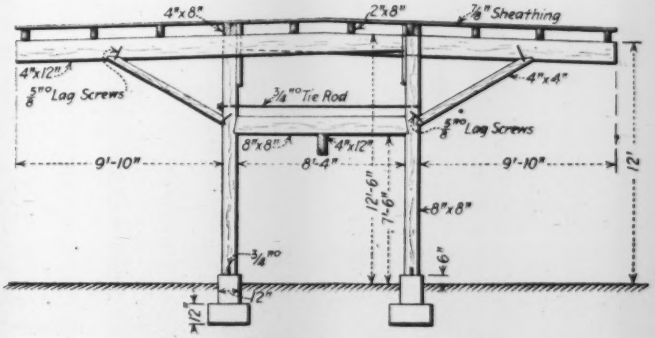
CONCRETE AND WIRE GLASS MONITOR EASY TO BUILD







SECTION THROUGH SKYLIGHT



SECTION THROUGH TELPHER SHED

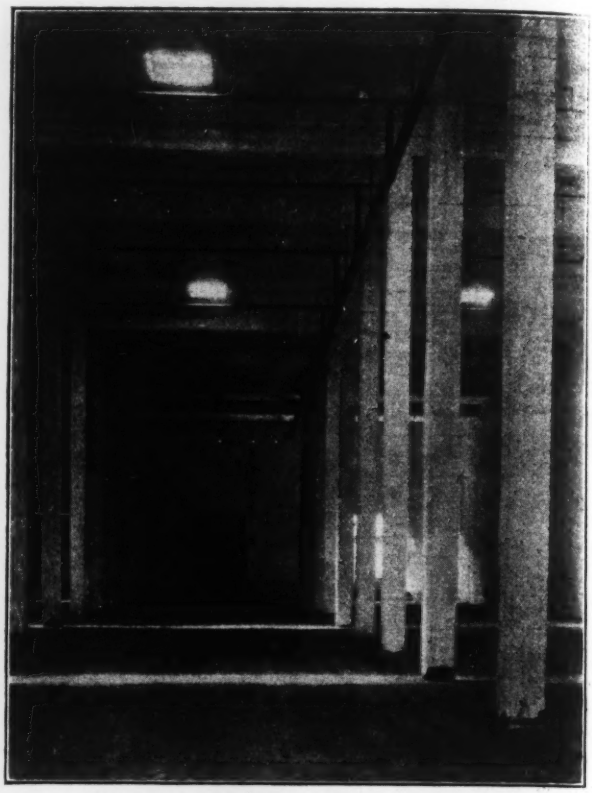
BUILDINGS WIDENED AND AISLES NARROWED IN LAST TWO UNITS UNDER CONSTRUCTION—COLUMN SPACING CHANGED TO GIVE LIGHTER ROOF

As the walls and columns are poured full height, concrete had to be hoisted to the top of the buildings for most of the work, while at the same time means had to be provided for laying the concrete floors on the ground surface inside the warehouses. This is accomplished by using a concrete plant with the mixer set at ground level and distributing the concrete in buggies. The mixer discharges directly into these for the floor work, while for the rest of the work it discharges into a skip operated in a short hoisting tower to the level of the roof. As the plant is placed between two units being constructed together, a light timber bridge is built past the face of the tower level with the roof and connecting with the runways on top of both buildings. The tower is short, the mixer is on skids and the entire plant can be taken down, moved and re-erected in a couple of days. This has been done twice when the distance which the concrete was being wheeled became too great, and the plant will be moved once more before the present units are completed.

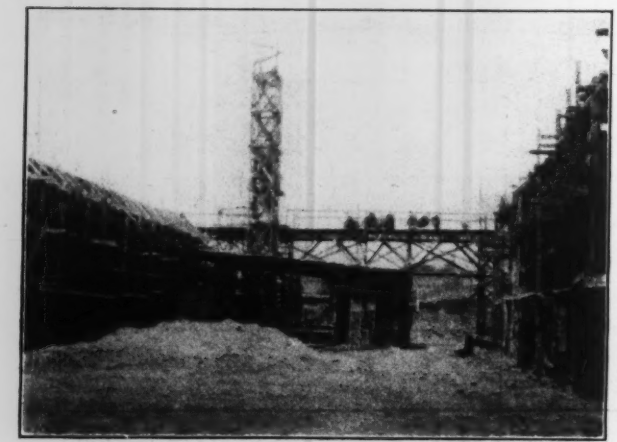
These buildings are divided into bays 45 ft. long by concrete fire walls, and the walls of a complete bay are formed and poured first on one building and then on the other. After the walls and columns of several sections on one building have been poured, the roof is concreted in slabs 120 ft. long containing 280 yd., placed and finished in one run. The walls and columns are poured full height in one operation.

The two buildings under construction at this time occupy the center of the group of warehouses. Concrete materials are delivered by rail and brought from the west side of the building. For this purpose a road was cut through along the line of the future telpher tracks, and sand and gravel brought in by teams and stored in piles in advance of the buildings.

Considerable grading was required at the site, a cut of 12 ft. or more being necessary along the line of the south building. This work is handled by a ¾-yd. revolving shovel, which was easily able to keep ahead of the concrete construction as long as teams could be supplied to remove the dirt. However, with the rush work being carried on for the United States Government at the National Army cantonment near Atlanta by the same contractor, it has become difficult to secure teams or trucks, and this shovel has had the task of keeping ahead of the work with 15 wagons, when it could easily have kept 18 busy. This was accomplished by abandoning a heavy cut where the shovel is shown working in the photograph and moving it over to the cut ahead of the other building, where but three feet of earth had to be removed. The stack of concrete materials shown stored here in the same photograph was used up in concreting the two buildings up to the point where grading on the deep cut was stopped. Meanwhile the shovel has removed the light cut, and this building was brought to completion while the hill in the way of the other unit was being removed to grade.



BEAMS PARALLEL TO BUILDING GIVE WIDE CROSS AISLES FOR HANDLING COTTON



TOWER DELIVERS CONCRETE TO BRIDGE AT ROOF LEVEL

Form work and sometimes concreting are carried on at night, the work being flood-lighted with two 750-candlepower Davis flood lights, mounted on towers erected on top of the units at either side. Several smaller lights are used also from time to time.

The Atlanta Warehouse plant is being built by Arthur Tufts, contracting engineer, of Atlanta, with E. A. Stuhrman designing engineer, the work in the field being in charge of C. R. Justi.

Outfall Sewer with Multiple Outlet

A contract for an 84-in. concrete submerged outfall sewer 3500 ft. long at the site of the proposed easterly sewage-works for Cleveland, Ohio, has been let to the American Construction Co. for $360,000. The outer 1000 ft. will be a tapered section of concrete with 6½-in. holes spaced on 7-ft. centers, the design being similar to that of the westerly outfall, described in the *Engineering Record* of Mar. 25, 1916, page 410.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Professional Ethics and Registration of Engineers

Sir—Your editorial entitled, "Professional Questions Call for Study," in your issue for Aug. 30, p. 386, touches upon a sore spot in engineering practice. While it is true that not many who claim to be engineers are guilty of morally questionable practices, the number who ignorantly or wilfully ignore or violate what has been accepted by the more conservative members of the profession as correct professional conduct, appears, as you intimate, to be rapidly increasing, and they are becoming more and more a disturbing and demoralizing element in the profession—if we may call engineering in its present condition a profession.

Your scheme to print and comment upon special cases is laudable and should bring out much that will be interesting and useful, particularly to the younger engineers who desire to know and to do what is right.

Your conclusions will doubtless confirm the views held and practiced by honorable engineers who adhere strictly to approved codes of professional conduct. But there is reason to fear that they will be lost upon that class who seem to regard professional ethics as excellent in theory, but to be observed in practice only where convenient. They have taken up and practice engineering as a business rather than as a profession, and are controlled by commercial morals and customs rather than by codes of professional ethics; and, since the spirit of the original code of ethics:

"He may take who has the power
And he may hold who can,"

is not wholly extinct in the modern business world, they apply the modern interpretation of it to their engineering vocation. Competition and smart practice is said to be the life of trade, and there can be no doubt that advertising, publicity and skillful promotion are profitable in engineering, as in other lines of business.

Engineers of this class do not stand in awe of the disapproval of the profession and do not much fear public opinion, which is callous and indiscriminating in matters of professional ethics. Even conscious incompetence may be no bar to their ambition and enterprise. If the merchant may exaggerate the quality and value of his goods, why should not they do so in the matter of their professional wares? Unless they violate the laws—and very few do that—there is no way of penalizing them for unprofessional conduct. It is true that most of the engineering societies have in their constitutions provision for expelling members guilty of unprofessional conduct, but not one of them, so far as I know, has ever disciplined a member for offenses of that character. In the absence of an adequate code of ethics defining specific offenses these societies doubtless hesitate to take the responsibility involved. In fact, most of this class of engineers are not members of these societies.

In short, it is to be feared that neither editorial teaching, moral suasion nor professional disapproval can be depended upon to remedy the situation. What is needed is the authority of the state to prevent or punish. In the other professions such authority is provided by the statutory recognition of the profession, the registration of competent and worthy practitioners, and appropriate penalties for those assuming to practice without such registration, or who violate moral or professional rules of conduct.

Engineering can never establish itself as a real profession until it secures like legal recognition and protection from incompetents, and power to control the actions of its members. Until then unprofessional conduct, resulting mainly from the attempt to mix business customs with professional ethics, will continue to exist and to increase.

S. WHINERY.

New York City.

One Hundred Concrete Dwellings Built as One Contract Job

Sir—We notice that in your article on our concrete house job at Donora, in your issue of Sept. 6, p. 442, you have stated in the last paragraph that the cost of erecting form work is averaging about 50c. per sq.ft. This should read "$0.0765 per sq.ft.," this figure being obtained by the addition of the three units appearing in the preceding paragraph.

On the last line of the preceding paragraph the unit of $1.25 per 100 sq.ft. should read "per 100 sq.ft. of form" and not "per 100 sq.ft. of wall."

LESLIE H. ALLEN,
Aberthaw Construction Co.

Boston.

Areas of Segments of Circles

Sir—Since the matter of approximate formulas for the area of the segment of a circle was referred to in your issue of Sept. 6, p. 470, your readers may be interested in a formula on p. 652 of Molesworth's "Pocketbook for Engineers," which may not be generally known (as I have not seen it in any other book):

$$\text{Area} = \frac{4}{3}h\sqrt{(0.626h)^2 + c^2}$$

where h is the altitude (less than the radius R) and c the *half-chord*.

Since

$$R^2 = c^2 + (R - h)^2$$

or

$$c^2 = h\ (2R - h)$$

it is readily changed into the form

$$\text{Area} = \frac{4}{3}h\sqrt{(0.626h)^2 + h(2R - h)}$$

which gives the area in terms of altitude and radius.

Results obtained by the use of this formula are remarkably close. For instance, the area of a segment of altitude 42 in. and radius 60 in. is found to be 3527.104 sq.in., or

$$\text{Area} \div R^2 = 0.97975$$

as against 0.97991 in Professor Marquard's table; that

is, the error is only about 16 parts in 100,000, or 0.016 of one per cent.

And even when the segment is a semicircle the formula gives area $= R^2 = 1.57300$, as against the actual value 1.570796...., involving an error of about 140 parts in 100,000, or 0.14 or one per cent.

Since the area of a parabolic segment of same base and altitude would be $\frac{4}{3}hc$, while Molesworth's formula for the circular segment is $\frac{4}{3}h\sqrt{(0.626h)^2 + c^2}$, it would appear that the radical is a corrected value of the factor c, to adapt it approximately to the latter segment.

I. P. CHURCH,
Prof. Emeritus, Applied Mechanics and Hydraulics
Cornell University.
Ithaca, N. Y.

There Is No Demand for Engineers, Insists Electrical Man

Sir—The writer, with other engineers, has noticed considerable discussion in your columns regarding the possible extraordinary demand for engineers which may arise at the close of the war. In the opinion of many there will be no great demand for engineers *to do engineering work*, because in the great activity which has been shown in the United States in the past few years there has been no such demand. There has been a great demand for young engineers to do clerical and semi-clerical work, but only a comparatively small demand for mature engineers to do real engineering work.

It may be somewhat difficult for an outsider to see this, but the case of the engineers of the large electrical companies shows it well. These companies send glib talkers to the engineering schools to get young engineers to enter their testing and other departments. They enter these departments under the expectation and the indirect promise that a glorious future awaits them. They start in at 20c. an hour (it used to be 10c.) and do work such as reading meters, which is of very little value and could just as well be done by mechanics or uneducated men. They are then taken into the engineering departments at the magnificent recompense of $14 per week. After about three years they are raised to something like $21 and put in charge of some special work and given some high-sounding title like "expert on relays" or other apparatus. About this time they fall for more "bunk" and get married. They may then be raised to $25 a week. After about ten years of experience they get about $125 a month. They are then more or less expert in certain lines of work.

Some day such an engineer wakes up and finds that the amount of salary he is receiving is not enough to bring up a family, especially when he has to pay about one-third of it for rent. He then attempts to improve his position by making a change, but finds out through friends higher up that it is useless to attempt to make a change while he is still employed; that is, he has to leave his job before he can get another. This, as can be easily seen, he is not in a position to do, consequently he works at the expert's magnificent remuneration until he dies, when his fellow workers take up a subscription to bury him.

The writer will concede that a brilliant engineer may get an adequate salary from one of these companies, but the trouble is that thousands of young men educate themselves as engineers to enter these companies and then are immediately given nothing but clerical work, or work which any well educated clerk could do. That there is no demand for electrical engineers *as engineers* in comparison with the number of men turned out of the engineering schools, can be shown as follows: The writer is personally acquainted with two or three hundred steadily employed engineers. These men will average eight years' practical experience. Some of them have been in charge of hundreds of thousands of dollars worth of so-called design work. Their average salary is not over $2000 a year, and scarcely that. During the past few years of good business, these men have had their salaries raised about 10%. Almost every one of them has tried to find a new location; five of them have succeeded. The writer is also acquainted with some thousands of mechanics—and there is not a man of these but has had his pay increased from 40 to 200 per cent.

This plainly shows that there is very little demand for electrical engineers, and a great demand for mechanics. Fifty graduate electrical engineers ought to supply all the demand for real electrical engineering that will occur in the United States after the war. These fifty men will not meet the demand for clerks to handle correspondence, trace up orders, work in testing departments or run errands, but they will be able to do all the real engineering work.

The writer recently was talking with an able consulting engineer making a fair living. He has handled the design of some of the biggest electrical installations in paper mills in the world. This man told me that he worked for five or six years for large power companies in Boston and that the maximum salary he was able to get was $100 a month. He was plainly told by the power company that this was all he could ever expect to get, that there was a vastly greater supply of electrical engineers than there was demand for, and that the number already in existence could do all the engineering work for the next twenty years without any new accessions.

In the opinion of a good many other engineers with whom the writer has associated, instead of increasing the number of engineering students and schools, it would be better to decrease the number of schools to about 5% the present number and the number of students to about 10%, and let the large corporations, and especially the electrical concerns, get their clerks, production chasers, repair men, etc., from the high schools and other places, which would not require seven years of training and the expenditure of about $7000 per student.

"ELECTRICAL."

[While our correspondent has presented an extreme and pessimistic view of the situation, yet it appears that the peculiar circumstances surrounding the electrical branch of the engineering profession, up to the entrance of the United States into the European war, certainly have prevented quite the same demand for electrical men as has been seen for civil, chemical or mechanical men. Since then the reports of engineering schools, as noted in our issue of Sept. 13, p. 493, have shown a heavy demand for men with electrical training.

There has long been a smaller demand for independent electrical practitioners than for civil or mechanical, since the great mass of electrical equipment is highly standardized and is produced on a large scale by comparatively few concerns. Under such conditions there is less need of new designs for each installation of machinery than is probably true of any other group of industrial accessories. It was not until ten years ago that the possibilities of this situation were at all widely recognized, and many young men were allowed to go on with electrical engineering who had started in under the old glamour of the word "electric."

Some men have remained in minor positions in the electrical branch when they might have done better to go into mechanical or chemical work, or even into business. If these men's educations had been as broad as is now universally recognized to be desirable—or rather if they had been thorough enough in natural science and a few fundamentals of engineering practice—and if the men had had ingrained into them the habit of engineering attack, they could have shifted with comparative ease. Of course, they would have had to start in minor places, but the pay would not have been far below that which our correspondent states still prevails, and promotion probably would have been more rapid. By undergoing a certain temporary hardship they would have made a large net gain.

There seems to be no reason why, in the electrical branch of engineering any more than in any of the other branches, it is useless to attempt to change positions while still employed. We venture to assert that the great majority of engineers do not give up their old place until the new one is secured. Many employers will accept an employed in preference to an idle man.—Editor.]

Making Right-of-Way Computations

Sir—In reading over your publication of my formula for right-of-way computations in the issue of Sept. 6, p. 439, I find that I omitted the parenthesis which should inclose the three interchangeable quantities following the plus-or-minus sign. The formula as copied from my reference card would then read:

$$x = D \pm \left(\frac{\pi AO}{180} = \frac{AO}{57.2958} = 0.0175AO\right)$$

This application of the parenthesis is perhaps not sanctioned by general mathematical usage, but I find it very convenient in recording in small space formulas such as the above, which have more than one convenient form.

P. E. STEVENS,
Consulting Engineer.

St. Paul, Minn.

Steam Jets To Thaw Frozen Ground

Sir—I notice in your issue of Sept. 13, p. 519, a description of the use of steam jets for thawing frozen ground. This method has been used locally, to my knowledge, for thawing when opening up water-pipe trenches in winter time, and where the frost was very deep. It seems rather peculiar that some of these mining methods of the far North have not been used more generally by contractors in this country. If this is supposed to be a new scheme for thawing frozen ground, it is certainly time that the matter be given some publicity through your columns.

Probably one of the best articles on this subject was printed in the *Engineering and Mining Journal* of July 3, 1915, and anyone who has work of this kind should read this article. It gives very complete information for making the steam points, as well as the method of connecting up the sweaters. There is also an interesting photograph in the *Engineering and Mining Journal* of Mar. 27, 1915.

The article above mentioned deals with thawing frozen ground for mining work in Alaska, and they have without doubt worked this question out to a point where it should be most successful.

St. Paul, Minn. AN INTERESTED SUBSCRIBER.

Machine Bolt Heads Smaller Than Nuts

Sir—Referring to the letter from F. D. Buffum, published in your issue of Sept. 6, p. 468, please note that not all of the steel manufacturers' handbooks publish only the dimensions known as the Franklin Institute or United States standard of bolts and nuts. The book entitled "Cambria Steel" shows both these standards and the manufacturers' standard sizes, as may be seen on referring to pages 334, 341, 342 and 343, in which these are given in full detail.

Manufacturers' sizes include square and hexagon nuts and square and hexagon bolt heads, which are smaller than the Franklin Institute or United States standard sizes. In the manufacturers' set of standards, however, the sizes of the bolt heads are not the same as those of the next smaller size nuts, as such figures would make the dimensions out of proportion. This is true, however, of certain sizes, such as the ¾-in. manufacturers' standard bolt heads, which have a short diameter of 1¼ in. and one of the manufacturers' standard sizes for ⅝-in. nuts, which is the same, namely, 1¼ inches.

GEO. E. THACKRAY,
Special Engineer, Cambria Steel Co.

Johnstown, Penn.

Schedule of Liquidated Damages in Highway Specifications

The Pennsylvania State Highway Department specifications for a $12,000,000 construction program, to begin soon, cover the subject of liquidated damages quite fully. In computing the contract time for completion of the work "the length of time expressed in days and parts of days, during which the prosecution of the work has been delayed or suspended in consequence of unsuitable condition of the weather or other unfavorable conditions, or by any act or omission of the Department and not by any fault of the contractor, is allowed the contractor and excluded from the contract time; and if the satisfactory execution of the contract requires work and material in greater amounts than set forth in the contract, the contract time is extended in the same proportion as the additional work bears to the original work contracted for."

Failure of a contractor to complete the work on time under these conditions will cost him as follows:

Amount of Contract	Amount of Liquidated Damage per Day
$5,000 and less	$10
More than $5,000 and less than $10,000	15
$10,000 and less than $20,000	20
$20,000 and less than $50,000	25
$50,000 or more	30

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

The Cost of Isolated Road Surveys

SINCE 1913 the State Highway Department of Illinois has made more than 400 preliminary surveys of roads under conditions which have made the comparative cost rather high, although the actual cost of $26.40 is but a small item of the final cost of the road and insignificant in comparison to the cost of errors that might have resulted from less careful surveys—or no surveys at all. This work was done on roads in short and entirely disconnected sections. As a result the cost of transporting men to and from the intersections was large in proportion to the amount of work accomplished after they had arrived at the work.

All of this work was preliminary in its nature, some of the surveys being made in prairie land and some in rough country. Altogether nearly 1100 miles of road were surveyed at an average cost of $26.40 per mile. The average rate was 0.84 miles per day and the average length surveyed was 2.66 miles.

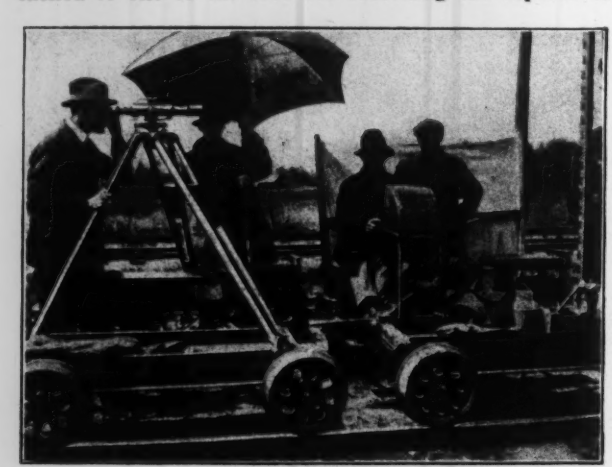
A typical party consisted of two engineers at $4 a day, three helpers at $2.50, and a team at $3. Such incidentals as transportation, board, lodging and supplies brought the total cost per day to nearly $25, and while this figure is less than the cost for similar work done by a private engineer, it does not include such charges as office expenses and profits.

Small Motor Cars Used on Precise Level Surveys

BY C. L. EDHOLM
New York City

MOTOR driven cars with flanged wheels for use on railroad tracks carry the outfit used by the United States Coast and Geodetic Survey in that part of their work which is upon railroad rights of way.

An interesting novelty is the adding machine attached to one of the cars for recording the reports of the parties engaged in precise leveling. A rigid frame, which holds the calculating device, is bolted to the body of the car. The operator is provided with a comfortable cushioned seat over the wheel, where he can do his work conveniently. The added reliability and greater speed of the machine for noting the readings of the level rods makes it a valuable addition to the equipment of parties in the field.



COAST AND GEODETIC SURVEY PARTY CARRIED ON LIGHT MOTOR CARS

Another car carries the level, the tripod being securely mounted upon the frame of the motor vehicle, and the operator standing in the space between the tracks. Flat trays, or hand barrows, on each car are available for transporting the other instruments, tools and personal belongings of the party.

The cars are light in weight, with frames formed of steel tubing, and are capable of traveling at a good speed with their load of instruments and passengers. A small gas engine under the frame supplies the motive power, and enables the party to reach its field of operations promptly and without fatigue.

Drafting Machine Automatically Computes and Plots Stream Discharge

BY W. NIMMO
Public Works Department, Hobart, Australia

A METHOD of computing and plotting stream discharge was recently developed by the writer for use in connection with a proposed hydrometric survey of Tasmania, and an instrument was devised to perform the necessary operations automatically. The principle on which the instrument operates is identical with that used in the method described by F. H. Kingsbury in *Engineering News-Record* of May 24, p. 422. Owing to the abandonment of the proposed survey, however, an opportunity of trying out the method in regular work has not yet presented itself.

The instrument is shown diagrammatically in the accompanying figure. *AB* is a straight-edge provided with a longitudinal groove. *CDEF* is a carriage consisting of four bars and having a fifth bar *GH* fixed at right angles to *CD*. The carriage runs on four wheels placed under the corners, those at *C* and *D* running in the groove *AB*. The plate *J* is a right-angled triangular plate (the center being removed to reduce weight) having a slot *K* parallel to one side and making an angle of 45° with *CD*. The plate can slide longitudinally on the carriage, being guided by the clips *L* and *M* on the bar *CD; N* and *O* are sleeves sliding on the bars *GH* and *DE* and carrying the tracing point *P* and the pencil point *Q* respectively. The pin *R* engages in the slot *K*, and a spring (not shown) keeps the pin *S* pressed against the template *T*.

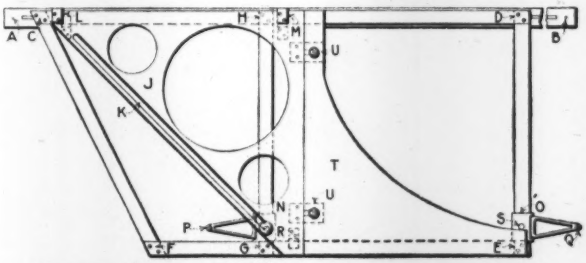
The template *T* is cut to the "station rating curve," obtained by plotting gage heights, to the same scale as used in the gage-height diagram, as abscissas, and the corresponding rates of discharge, to any convenient

scale, as ordinates. The template is secured to *J* by the milled screws *UU*. If the tracing point *P* be moved a given distance along *HG*, then the template *T* is moved the same distance to the right, and therefore if *P* is moved over the "gage-height curve," then *Q* will trace out the corresponding "discharge curve."

The area of the "discharge curve" multiplied by a factor whose value depends on the units and scales used gives the total discharge for the period represented by the "gage-height" curve. This area may be most conveniently obtained by means of a planimeter of the rolling type, and if the instrument be so arranged that the pencil point *Q* serves also as the tracing point of the planimeter, then the "discharge curve" may be plotted and its area read off at one operation.

If it be desired to investigate the discharge of the stream in detail, as, for instance, in studying flood records, the planimeter may be replaced by some type of integraph. (An integraph is an instrument provided with a tracing and a pencil point; and it is so designed that if the former be applied to any given curve, the latter will draw a second curve, the difference in height between any two ordinates of which is proportional to the area contained between the original curve, its abscissas and the two corresponding ordinates.) If the pencil point *Q* be used as the tracing point of the integraph, there is obtained a curve whose abscissas represents time to the same scale as in the "gage-height" and "discharge" curves, and the difference between any two ordinates of which is proportional to the total discharge during the corresponding time. In other words, a mass curve is obtained whose slope at any point indicates the rate at which water would accumulate if the total flow were impounded.

The methods outlined above are especially intended for use in connection with automatic water-level recorders, but even where single daily gage heights only are available, if the "gage-height" curve be first plotted, the "discharge" curve and its area may be obtained in



STREAM DISCHARGE COMPUTING AND PLOTTING OPERATIONS ARE PERFORMED BY MACHINE

one operation. Where a mass curve is to be plotted extending over a period of years, such as would be employed in investigating a storage proposition, the total monthly discharge only would be used, in order to keep the length of the curve within reasonable limits. The integraph method cannot, therefore, be applied in this case, and the monthly discharge must be first obtained with the planimeter, and the mass curve plotted in the usual manner.

The "discharge" curve cannot be plotted by the instrument on the same diagram as the "gage-height" curve, but this disadvantage may be outweighed by saving in time and the avoidance of clerical errors.

White Bridges Can Be Seen at Night

THE PRACTICE of painting highway bridges white so as to increase their visibility and thereby decrease possible accidents, is growing. A Tama County bridge on the Lincoln Highway in the Indian reservation and over the Iowa River is painted white, according to the *Service Bulletin* of the Iowa State Highway Department. People who cross this bridge at night who are accustomed to black or red bridges are struck with the ease with which the outlines of the bridge are noted. In Putnam County, Ohio, several truss bridges have been painted as shown in the view. The end posts of truss and railing are white for their full length but the inner railings and posts up to a height of 4 ft. are painted black as a protection against spatter from the road or discoloration from dog urine.

WHITE BRIDGE IS READILY SEEN

Concrete Specifications Have Some Special Features

THE specifications for concrete and reinforced concrete on the new bridge for Summit County, at Akron, Ohio, written by the engineers, Harrington, Howard and Ash, of Kansas City, Mo., contains some interesting features. In the first place the standard specifications for cement of the American Society for Testing Materials have not been used; instead, the engineers have their own specifications, the main points of difference being that the neat cement requirements are retained and the fineness is prescribed as 92% on a 100-mesh screen, and 75% on a 200-mesh screen.

In mixing and placing concrete the time of mixing is described as follows: "After the last ingredient is deposited in the mixer it shall be operated at least 1½ minutes or enough longer thoroughly to mix and incorporate all ingredients to the satisfaction of the engineers."

Consistency is defined in the following sentences: "Proper apparatus shall be provided that will insure a correct and uniform quantity of water, and it must not be left to the operator to judge the amount for each batch. The quantity of water used shall be such as will produce a mixture of concrete plastic enough to flow sluggishly in forms, and around timbers or reinforcing bars when properly spaded and otherwise agitated by proper tools. The concrete must not be so wet as to cause the aggregate to separate from the water, and water shall not be used or added in an endeavor to insure the flow of concrete in the chute. The addition of water to concrete after it has left the mixer will not be permitted."

In reference to chutes there is the following sentence: "Where concrete is transported in inclined chutes only metal chutes will be permitted. Special care must be taken to prevent the separation of the aggregate from

LUMBER SCHEDULE FOR ONE BAY

Mark	Pieces	Size	Length Ft.	Length In.	Panel No.
F 1	11	1 x7½	14	0	Floor Sheath
F 2	9	2 x6	6	9	Floor Joists
S 1	5	4 x4	12	0	Tee Studs
S 2	9	4 x4	10	8	Tee Studs
1 B 1	6	1½x8½	14	0	1BS
1 B 2	6	1½x5½	14	0	1 BS
1 B 3	6	2 x3	13	6	1 BS
1 B 4	12	1 x3	1	2	1 BS
1 B 5	18	1 x4 Sp.	1	2	1 BS
1 G 1	4	1½x5½	6	4½	1 GS
1 G 2	4	1½x8½	6	4½	1 GS
1 G 3	4	1½x7½	5	6	1 GS
1 G 4	4	1½x8½	9	2	1 GS
1 G 5	2	1½x8½	3	8	1 GS
1 G 6	2	1½x5½	6	9½	1 GS
1 G 7	2	1½x8½	6	9½	1 GS
1 G 8	2	1½x7½	11	0	1 GS
1 G 9	12	1 x3	2	6	1 GS
1 G 10	8	1 x3	1	2	1 GS
1 G 11	4	1 x3	1	8	1 GS
1 G 12	2	1½x5½	9	2	1 GB
1 G 13	2	1½x7½	9	2	1 GB
1 G 14	2	1½x5½	12	10	1 GB
1 G 15		1½x7½	12	10	1 GB
1 B 6		1½x8½	14	0	1 BB
1 B 7	3	1½x3½	14	0	1 BB
1 G 16	2	2 x3	8	0	1 GS
1 G 17	2	2 x3	13	6	1 GS

the mortar and the chutes must not be at a flatter incline than 6 in. to 1 ft."

A novel provision is that in adding new concrete to old, not only shall the old be thoroughly cleaned by removing shavings, sawdust, débris, laitance, etc., but the surface over an area about 6 in. wide next to the form shall be *scraped* before new concrete is placed. This is evidently a provision against surface seams, for the specifications continue, "Where the old concrete has set for several days, or where large-size aggregate is used, or elsewhere when the engineers consider necessary, the above described area shall be covered with mortar of the same proportions as that in the concrete, about ¾ in. deep before new concrete is placed thereon, and in the placing care is to be taken so that the large aggregate will not appear against the form, so that no open seams will be apparent."

In the specifications for reinforcement not only rerolled steel is prohibited, but bessemer steel is also. The specification says: "Any attempt to substitute steel manufactured by the bessemer process or from old steel rails, will be considered a violation of the contract and an adequate reason for its cancellation."

The bridge is a very large one, totaling 2791 ft. long, and is to be entirely of reinforced concrete. It includes 16 arch spans varying in length from 116 to 191 ft., and 12 girder spans totaling about 300 ft. There is a 52-ft. roadway with two 10-ft. sidewalks.

Lighting a Drafting Office

THE lighting of the large drafting office of the Northern Pacific Ry. at St. Paul, Minn., was only noted briefly in the description of that office in *Engineering News-Record* of June 28. A correspondent has inquired as to the details of the electric lighting, and the following information has been furnished by H. E. Stevens, Chief Engineer, Northern Pacific Ry.

The indirect system of lighting is used. The lighting fixtures are spaced about 8 ft. longitudinally and 9 ft. transversely. The room is 11 ft. 2 in. high. Reflectors 15 in. in diameter are suspended about 18 in. below the ceiling. Photometric tests with 100-watt "C" lamps previous to installation, gave an average of about 8-ft. candles at 2½ ft. above the floor level.

The drafting room was first put into use in December, 1915, and the good results of the photometric tests led to the temporary use of 100-watt type "C" lamps in the fixtures over the drafting-room tables. These same lamps were also used during the winter of 1916-1917, but were somewhat unsatisfactory the latter part of the winter. This fall they will be replaced with the 200-watt "C" lamps originally contemplated, or with 150-watt "C" lamps if they are on the market. In that portion of the room where no drafting work is done, 80-watt "C" lamps are used.

The indirect lighting is practically shadowless, which, of course, is a very desirable feature in a drafting room. The lights are arranged in six rows, parallel with the outer walls. They are connected to the switches in rows parallel to the outer wall, so that in dark days the interior portion may be lighted as much or as little as may be required and natural light used in the outer portions.

Cut Joint Filler in Concrete Pavement with Steel-Cleated Shovel

Joint filler in concrete pavements should be trimmed so as to leave about ½ in. of the material extending above the pavement. This surplus is ironed down by the traffic and forms a better joint than if cut off flush with the concrete. An economical way of cutting off this filler according to the *Concrete Highway Magazine* is shown by the accompanying photographs. Two steel cleats on the underside of the shovel allow it to ride about ½ in. above the surface of the pavement leaving a uniform surplus extending above the road.

SHOVEL WITH CLEATS CUTS JOINT FILLER UNIFORMLY

HINTS FOR THE CONTRACTOR

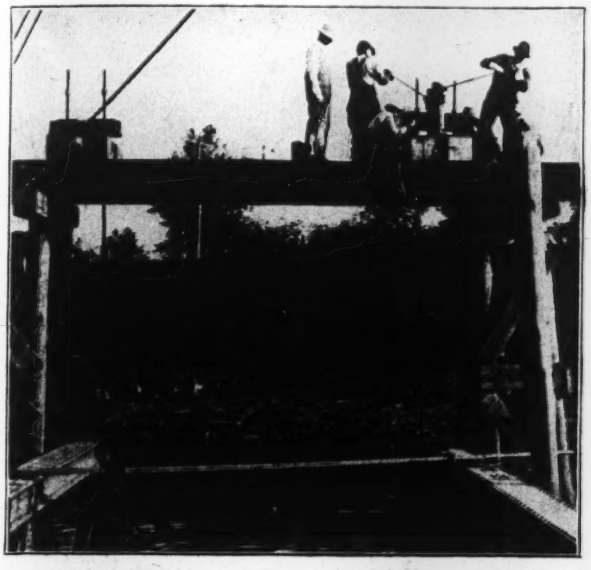
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Raise Sunken Bridge Span with Jacks and Long Threaded Rods

By S. Standish

Standish & Allen, Engineers and Contractors, Chicago

A NINETY-FOOT pony truss span belonging to the Evansville & Indianapolis R.R., which was washed out on the White River near Rogers, Ind., was raised clear of the water without difficulty by the method



NUTS WERE USED TO ADJUST JACKING YOKE

shown in the photographs. The span had been carried about 1000 ft. downstream, and had landed in an upright position some 50 ft. from the south bank of the river. At low water the top 3 ft. of the trusses was exposed. The span lay in a nearly horizontal position.

Two gallows frames were erected, one over each hip of the span. The legs of these frames consisted of four pile towers, and the cross beams of six 8 x 16-in. stringers. Each hip joint was hung from a pair of 1¼ threaded rods 18 ft. in length. Above the cross beams each pair of these rods was connected by a timber yoke bearing under nuts screwed down on the rods. The raising was done with two 25-ton Norton jacks, the nuts being used merely to adjust successive grips on the rods. The ends of the span were raised alternately, one jack being set over each joint, and each end being raised about 2 ft. at a time. After the bottom flanges of the floorbeams cleared the water by about 4 in. raising was stopped, two additional bents of falsework placed, and the span dismembered, the pieces being loaded on scows and taken to a repair shop on the north bank of the river.

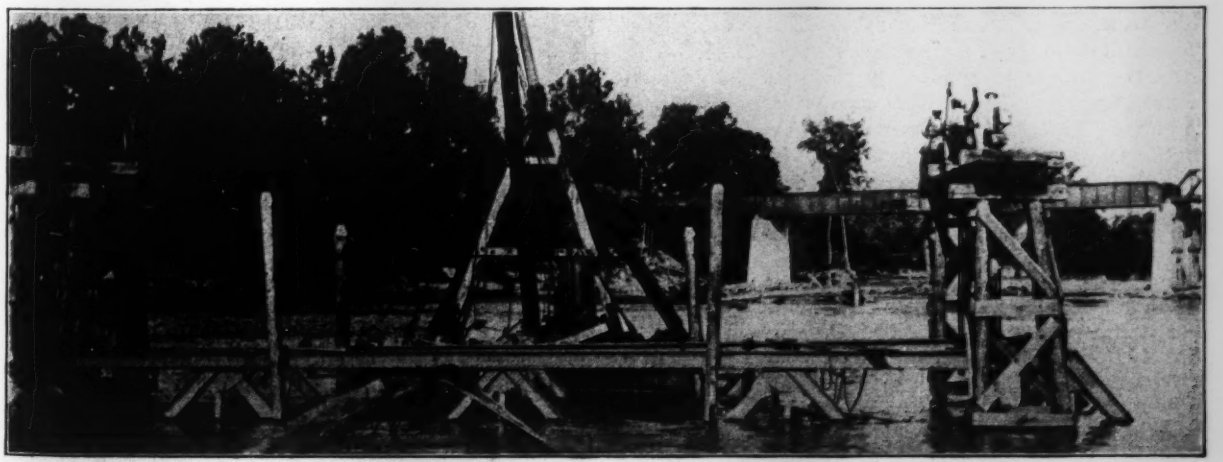
The work was done for the Evansville & Indianapolis R.R., of which C. B. Falley is general superintendent, by Standish & Allen. W. S. Allen was construction superintendent.

Carriage Guides Lengths of Concrete Sewer Placed in Tunnel

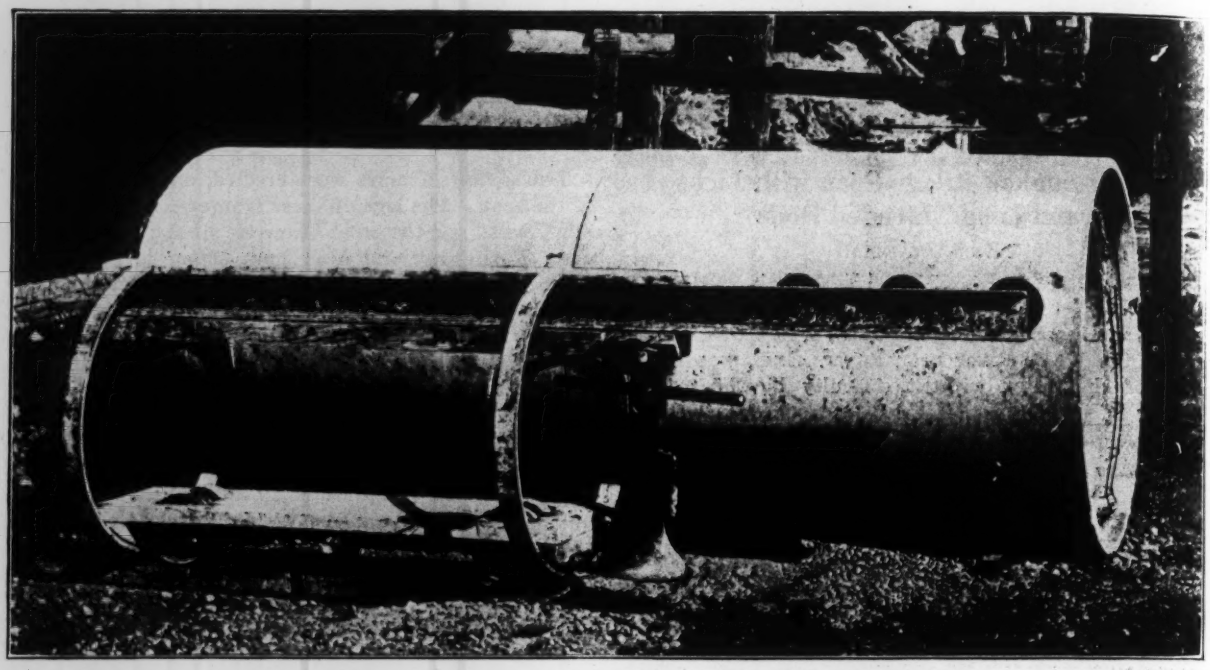
By A. G. Dalzell

Engineer of Sewers, Vancouver, B. C.

THE CARRIAGE shown in the photograph, designed by the writer to aid in jointing sections of 30-in. lock joint, reinforced-concrete pipe laid in a sewer tunnel, has proved very successful. The beam at the top of the carriage is 8 ft. long, which is equal to two lengths of pipe. It is made of two 4-in. channels let into a 6 x 8-in. timber which is shaped on the top edge to fit the inner circumference of the pipe. In the projecting part of this beam are fitted three 5-in. wheels, the tops of which are flush with the top of the wood beam. This beam is bolted to two iron hoops of about 28½ in. diam-



NINETY-FOOT SPAN RAISED ALTERNATELY TWO FEET AT EACH END UNTIL CLEAR OF WATER



CARRIAGE IS JACKED UP INSIDE LAST LENGTH AND NEXT LENGTH IS ROLLED TO PLACE

eter, which are attached to a small truck on four small wheels. An ordinary screw jack, fitted with a hardwood base, shaped to the circumference of the pipe and with a square plate at the top engaging a slot in the end of the wood beam, completes the device.

The carriage was set in the first length of pipe laid in the shaft. The jack was then inserted and screwed up, lifting the entire carriage until the beam was tight against the top of the pipe. The next length was then wheeled up to the projecting end of the beam on a low truck and rolled forward, bearing on the wheels set in the beam. The length of pipe being set is thus accurately guided into place and is easy to handle. The invert of the length being placed can readily be adjusted to exact grade by lowering the jack or inserting a small filler under the top. When the joint has been made snug and the length adjusted to grade and blocked, the cantilever beam holds it in place until concrete is packed beneath it. The jack is then released and the carriage moved forward.

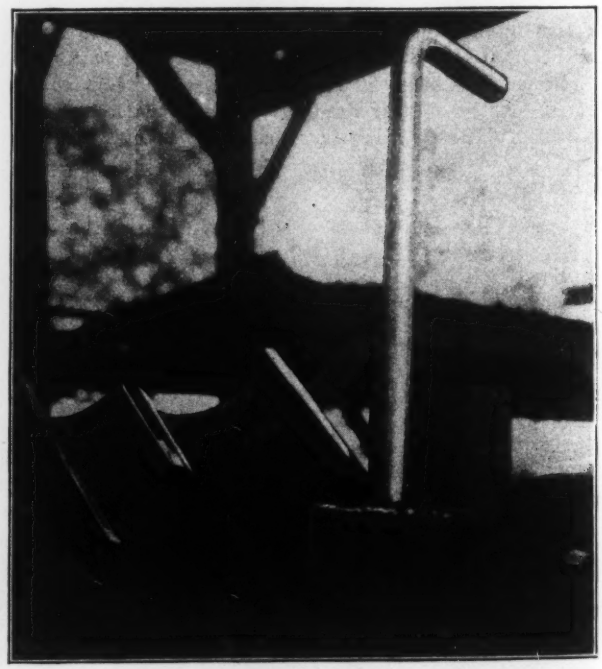
As the jack is suspended, by the square head mentioned, from the beam, it is carried along with the carriage. When the pipe layer wishes to crawl to point up the joints, however, the jack has to be taken off. It is then possible for a man to crawl through the carriage, or to propel himself along the sewer on the carriage. For a larger size of pipe two jacks would probably be necessary. About 2000 ft. of pipe was laid in tunnel under the writer's direction with this rig.

Providence Water Consumption Is Low

Supplying water to an estimated population of 284,400, including outside towns, the water-works of Providence, R. I., showed a per capita consumption of 63 gal. per inhabitant in 1916, according to the report of the city engineer for that year. About 93% of the services were metered.

Oval Concrete Spacer Blocks Save Time in High Wall Forms

WALL FORMS used on the Atlanta Warehouse and Emery University Buildings by Arthur Tufts are held accurately in position by bolting them through the precast concrete spacing blocks shown in the illustrations. Not only are the forms held true, but the bolts are easily withdrawn by hand when stripping, and leave clean round holes which can readily be plugged. With 8-in. walls of the 18-ft. height required in the Atlanta



BLOCKS MADE IN HINGED MOLD

Warehouse, where the method was developed, it is next to impossible to line the forms up without spacing blocks, and if wooden ones are used they cannot be removed from the narrow section. With the concrete spacing blocks the wall forms are self-supporting, and do not require any bracing.

At the Emery University buildings, where appearance counts for much, oval blocks, placed with the long point down, are used to eliminate the chance of little

BLOCKS THREADED ON FORM RODS

stony pockets forming under the blocks. Where this is done the location of the blocks in the finished walls cannot be detected after the bolt holes are plugged. At the warehouse, however, where it is scarcely expected that afternoon teas will be held, less attention is paid to this point, and round blocks are used.

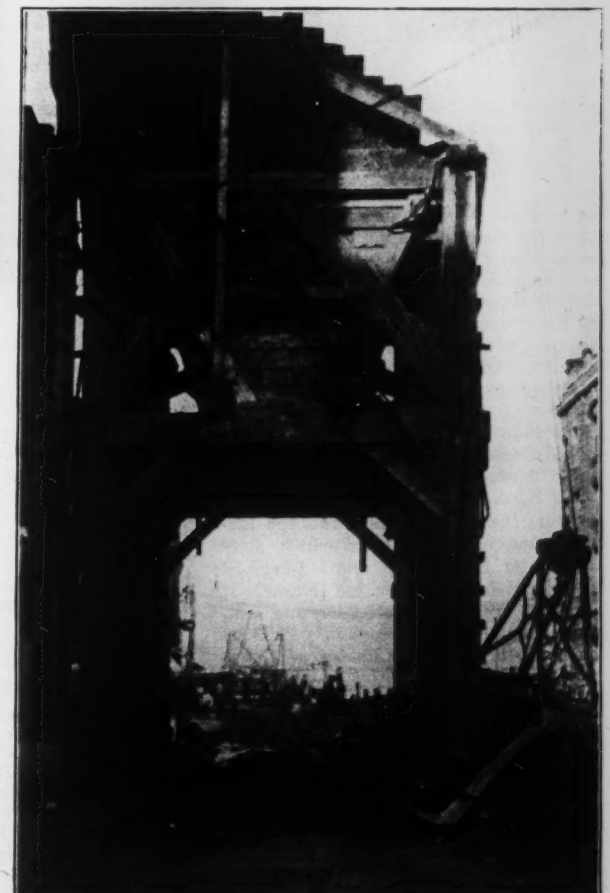
The blocks are made by one man working continuously, although two sets of molds are on hand at the warehouse so that the work can be speeded up when the supply of blocks runs low. The mixture of sand and cement is made just dry enough to keep its shape after packing with a wood tamping block, and removing the mold. Each mold bench has a wood plug with a hole in the center for the pin which forms the bolt hole. The mold is clamped around this plug, and filled and packed level to the top with the dry mortar. It is then taken off, the pin is withdrawn and the blocks are stacked on end to set.

The holes made by the pin are sometimes a little out of line. Therefore, in using the blocks only the inside form is bored for the bolts before assembling. This erected, the bolts inserted and the blocks threaded on them, an outside form panel is raised up and blocked in place against the bolts. The holes are then marked in this panel, and it is laid down to bore them. The outside form is then raised to place and the bolts drawn tight. The strips containing bolt holes in the outside form panels are replaced with new plank at each setting.

The work mentioned on which this method is in use is being carried out by Arthur Tufts, engineer and contractor, of Atlanta.

Mount Dirt Hopper on Inverted Timber Dollies

THE Bates & Rogers Construction Co. is using dirt hoppers mounted on timber dollies to load trucks at the excavation for the west subway approaches to the Detroit-Superior viaduct, Cleveland. Attention was called in the article describing this work, which appeared in *Engineering News-Record* of July 26, p. 148, to the contractor's choice of a locomotive crane and a traveler derrick, loading trucks by means of movable dirt hoppers, for excavating the double-track cuts in Detroit Avenue and Twenty-Fifth Street. Hoppers of larger size than could be conveniently picked up and moved by the hoisting equipment were employed by mounting each of them on six or eight inverted timber dollies and rolling them along plank runways laid on the curb. The hoppers when empty are pulled along with a runner line.



HOPPER MOVES ALONG CLEVELAND SUBWAY CUT ON TIMBER DOLLIES

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Proposes That San Francisco Buy United Railroads

The plan evolved by a committee of bankers named to handle the financial reorganization of the United Railroads of San Francisco was presented to a conference of city, financial and labor interests, and was placed before Mayor Rolph, Jr., on Sept. 24 by the officials of the road. While details of the plan have not yet been made public, so far as can be learned, the plan calls for the leasing of the property by the city with stipulations that a percentage of the receipts be applied to the purchase of the property. The proposed purchase has been in issue since announcement by the president of the road, J. W. Lilienthal, that the finances of the property prevented it from granting the wage increase demanded by 1700 of its platform men who went on a strike eight weeks ago.

Jersey City Decides to Reopen Water-Supply Contract Suit

By a unanimous vote the Commissioners of Jersey City have decided to attempt to secure a reconsideration by the Court of Chancery of its decision that the water chlorination plant built at the Boonton reservoir by the Jersey City Water-Supply Co. relieved the company of any necessity of diverting the sewage of Rockaway valley towns below the Boonton dam. The resolution recites the fact that both its corporation counsel and special counsel have advised the city that the company cannot be compelled either to build or pay the cost of a trunk sewer and directs the corporation counsel to engage as new special counsel Albert C. Wall, who has given an opinion that he can secure a reopening of the case. Earlier notes on this subject appeared on pp. 481 and 522 of our issue of Sept. 13 and 573 of Sept. 20, 1917. The hypochlorite plant at the Boonton dam and the litigation and other reasons which gave rise to its installation were described at length in "Engineering News" of June 24, 1909, pp. 697-700, and editorial comment appeared on p. 693 of the same issue. The Master of Chancery report on which the decision was based in the suit Jersey City wishes to reopen was abstracted in "Engineering News" of June 9, 1910, p. 686.

Will Give Course on the Administration of Corporation Schools

At the request of the executive committee of the National Association of Corporation Schools, New York University has inaugurated a course to cover "The Administration of Corporation Schools" which will be under the Management Division of the School of Commerce and Finance, Dr. Lee Galloway, director. The object of the course will be to develop competent persons to inaugurate direct educational activity for industrial corporations.

The course opened on Tuesday evening, Oct. 2, at 7: 45, at the down-town branch of the New York University, which is at 32 Waverly Place, on Washington Square, New York City. Enrollments will be received until Oct. 20, and should be made through the University. Further information may be obtained from Major B. Foster, at the above address.

Christmas Packages for St. Louis Engineer Regiment

A committee of the St. Louis Engineers Club has been appointed to coöperate with the Ladies' Auxiliary of the 12th Engineers, who have undertaken to send every member of the regiment a Christmas present. The Engineers Club has decided to furnish 1000 packages of tobacco for these parcels, and at its meeting Sept. 12 the club authorized an expenditure to cover this gift.

Official Committee Improving War Service of Engineering Schools

Has Consulted with Heads of Various Bureaus. Suggests Drafted Engineers Be Assigned to Technical Services

THE relation of American engineering schools to the Government in the present emergency has been studied by a special committee of the Society for the Promotion of Engineering Education, appointed by Hollis Godfrey, of the Advisory Commission of the Council of National Defense. This committee includes F. L. Bishop, chairman, C. S. Howe, M. S. Ketchum, C. R. Mann, S. P. Capen, secretary. The probable needs for scientifically and technically trained men in connection with the military operations has been considered in consultation with the heads of various bureaus, divisions and departments of the War and Navy Departments. Conferences have also been held with representatives of the Council of National Defense, the Shipping Board, the Department of Labor, the National Research Council, the Federal Board for Vocational Education, and the Bureau of Education.

The committee had recommended that an engineer familiar with the equipment and capacity of the higher technical institutions of the country be commissioned in the army and assigned the task of coördinating the needs of the army for technically trained men with existing educational practice. The committee has held conferences with an officer who was appointed by the Secretary of War to study the needs of the War Department for technically trained men.

Short-Course Training Needed

It was found that there were a few definite needs in the way of short-course training wherein the technical schools might be of considerable help. A typical problem is that of the Signal Corps, which desires technical instruction for six depot companies, one for each army department, each depot company consisting of 175 enlisted men. Fortunately the committee found an institution equipped and ready to furnish this training. To save the waste of talent which would result from the use of a technically trained man in troops of the line, the committee undertook to secure for the Secretary of War lists of such students so far drafted in the National Army. The committee has compiled a list of engineering schools whose graduates may be considered eligible for competitive examination for appointments as acting ensigns in the Navy for engineering duty only. This would be in accordance with an act of Congress, which was approved Aug. 29, 1916.

The committee is not yet prepared to recommend any fundamental changes in courses of study as the result of its investigation. Certain military engineering topics, however, should be introduced into the regular courses. These will tend to satisfy the patriotic enthusiasm of engineering students, and will prove profitable to those who go into the army. Such topics as military-bridge building, laying out and sanitation of camps, the making and reading of maps, rapid reconnoissance, and the laying out of trenches, should be studied, and it is suggested that the textbook used by the army be used. The committee recommends as especially valuable "The Engineer in War," by Major P. S. Bond. The list of textbooks used in the mliitary schools may be secured from the U. S. Infantry Association, Union Trust Bldg., Washington, D. C.

A complete report will be issued by the committee in the near future, and in the meanwhile it will be glad to answer, as far as it is able, inquiries concerning the relations of engineering schools to the National Government. Communications should be addressed to the secretary of the committee.

Road Builders!

Colonel E. N. Johnston, 23rd Engineers, needs your help in organizing a highway construction regiment of 10,500 men for immediate service in France.

He has asked Engineering News-Record to carry the message to you.

Full Details on Pages 625 and 626 of This Issue.

Portland, Ore., Relaxes Fireproof Building Ordinance

The City Council of Portland, Ore., has passed a resolution repealing the ordinance prohibiting anything but fireproof buildings in the main business district and allowing the erection of buildings up to four stories in height with fireproof walls and wooden interiors. Each floor of such a building must, however, be equipped with an automatic sprinkler system.

The ordinance, which becomes effective at once, marks the end of a long fight between property owners who have erected fireproof buildings in this district and the owners of vacant tracts and out-of-date structures. Architects are of the opinion that the repeal of the former ordinance means that building will be stimulated to a marked degree at once.

No Engineer on New Illinois Waterway Commission

Navigable waterway connection between the Chicago Drainage Canal at Joliet, and the Illinois River at La Salle, Ill., is to be investigated by a Board appointed by Governor Lowden under the new State civil code. This Board will act in connection with the Department of Public Works and Buildings. It is composed of E. S. Conway, Joy Morton, and John T. Pirie, of Chicago; George T. Pope, of Peoria; and Charles B. Fox, of East St. Louis. All are business men, and there is no engineer on the Board.

Public Health Association Changes Meeting Place to Washington

Owing to "circumstances connected with the war" both the time and place of the 1917 annual meeting of the American Public Health Association have been changed. The convention will be held at Washington, D. C., instead of New Orleans. The date has been tentatively set as Oct. 20-27, instead of Dec. 4-7. Dr. W. A. Evans, of Chicago, president, announces that the "central theme of the meeting will be the welfare of the soldier, sailor and civilian in time of war." Early hotel reservations are advised In the absence of Secretary S. M. Gunn with the Tuberculosis Commission in France, A. W. Hedrick (126 Massachusetts Ave., Boston) is acting secretary of the association.

Construction Field Is Adjusting Itself to War

Not Too Soon To Begin Looking Forward to Peace, When Great Activity Is Predicted

AT present the Government, the people and our allies are attempting to consume our products somewhat faster than the labor available can produce them. At least, according to an analysis of the situation presented in the latest business letters of the National City Bank that theory will account for advancing prices and continued movements of labor for higher wages. Of course, advancing prices will ultimately check the tendency to consume more than can be produced. But the curtailment will have to take place in the consumption of the general public, as the necessities of the Government and our allies must be satisfied. One of the directions in which this curtailment is being and has been felt is in new construction. Industries that could find a ready market for increased output do not build because the labor to increase their output cannot be had. Public work is not coming out in the volume that would be expected if prices were lower. Investment in new enterprises is curtailed by the demand for money and means to carry on the war.

But because of this checking of ordinary work the country is going without new facilities which it will need all the more immediately when the normal course of national life is resumed. For this day farsighted men should now be planning. Extensions of transportation facilities, power developments, improved municipal utilities, increased building construction will all be needed. This development, held back by the necessity of the present hour, must come after the war.

Whether a period of stagnation will intervene, or whether an orderly readjustment to normal conditions will be possible must depend on public confidence. Money for private financing is of course growing scarcer. Call loans have recently advanced to 6 per cent., and the Secretaries of the Treasury and War Departments have publicly asked that private, state and municipal enterprises be held in abeyance until the requirements for the war, which will temporarily draw heavily on the thrift and resources of the public, have been met. But the enormous sums being thus raised by the nation will soon be assets, and will never represent a total loss. They are not passing out of the country, but being spent in it. Consequently this money is not subtracted from our future financial resources, but merely borrowed temporarily to make possible the production and assembly of things needed to prosecute the war. The net loss is represented only by such of these products as are consumed in waging war. It cannot be said to exceed to any crippling extent the wastage and consumption of normal times. The main thing is that the money which paid for and so called forth the production of these goods will remain in our hands, to be reinvested as capital in facilities which we are now doing without, and which will have to be provided at a rate above normal after the war is over. No period of stagnation will occur if the public, into whose hands this money will come as profits or as wages, does not become afraid to invest it during the period of inevitable readjustment after the war.

While planning for the future is a most important duty of engineers, contractors, and manufacturers in the construction field, the period of war is proving not without occupation and opportunity. The shipbuilding program and emergency construction for the Government are employing the organizations of a great proportion of engineering and contracting firms and the output of many manufacturers. Moreover, it is believed that the manpower and financial strength of the country will enable it to avoid the abandoning of normal development to the extent that has been necessary in the case of the Central Powers and of our Allies. Thus it appears that we will not have to neglect the development of our highway systems, of ports and terminals and of other facilities not vital to the waging of war, but which will greatly increase the efficiency of our efforts. Work of this sort, in addition to that for the Government ought to fully occupy our construction forces, now reduced by the drafts made on them for military service.

The fixing of lower steel prices cannot, of course, be expected to produce a building boom. But, on the other hand, Government demand for steel products, given preference over the field at fixed prices by a priority board, can hardly shut down all construction requiring steel. It must be remembered that the labor shortage, expressed in rising prices, has for some time held construction activity below the volume it would otherwise have reached. The further effect of the withdrawal of one or two million men and the conversion to war uses of a vast amount of capital will of necessity be taken up to a great extent by curtailment in many industries producing luxuries and nonessentials before it is felt directly in the construction field.

The outlook, therefore, as the national army and the second war loan are being raised, is far from depressing. A busy future awaits the promoter and builder at the close of the war, and in the meantime most, if not all, of our construction forces seem destined to be kept extremely busy.

Government Wants Roads to Seaboard Improved

At a conference of state highway engineers held at Detroit, Sept. 25, 1917, Government representatives stated that the coming winter is likely to produce an urgent need for heavy road transportation on a large scale from Great Lakes points to the Atlantic seaboard. R. C. Hargreaves, chairman of the committee on storage of the Council of National Defense, called the meeting. The state highway departments of Michigan, Indiana, Ohio, New York, Pennsylvania and Virginia were represented. A general line of action was agreed upon for the purpose of selecting practicable through routes and getting them in shape to carry heavy motor-truck traffic all through the winter.

The thousands of army trucks recently ordered by the Government will probably have to be moved over the roads in order to avoid tying up a large amount of railway capacity that cannot be spared. Other traffic may have to be moved by way of roads in emergencies, especially when rush shipments are held up by railway congestion or interruptions. For these purposes it is urgently necessary at once to put in shape through routes from such points as Detroit, Toledo, Cleveland and Akron to Atlantic ports.

The facts set forth by the state highway engineers showed that such through routes do not exist at present—none at least that would stand up under heavy motor-truck traffic in winter. But it is possible to select through routes that offer hard surface everywhere except on short stretches which can be put in shape within the next month or two. Temporary surfacing of gravel or stone will be put on these unsurfaced sections, and continuous maintenance work throughout the winter will be arranged for.

The National Pike contains unimproved gaps too long to permit of surfacing in time for the present need—for example, the part from Lisbon to East Liverpool in Ohio. The Lincoln Highway is in good shape east of Pittsburgh, but thence west to the Ohio line and on several stretches in Ohio it is unimproved. A stretch near Monroe, Mich., between Detroit and Toledo, is almost impassable and cannot be put in shape for the expected winter use except by temporary gravel surfacing. The main road along the Lake Erie shore and east through New York is reported to have some weak bridges.

The two main routes in contemplation are the Lake Shore Road and the Lincoln Highway, the latter, however, to be used only east of Pittsburgh, being reached by a system of existing paved roads from Akron southeastward, passing west of Youngstown. State and county coöperation will be applied at once to the task of getting the routes into shape, after their selection by conference of the highway authorities of neighboring states.

It is expected that within a month the roads to be used will have been selected.

Major Ridley in Charge of Public Buildings at Washington

Maj. Clarence S. Ridley, of the Corps of Engineers, United States Army, on duty at the War Department, has been assigned to take charge of public buildings and grounds of the District of Columbia, and also as chief military aid to President Wilson. He succeeds Col. William W. Harts, Corps of Engineers, who was relieved at his own request, in order that he might perform duty with troops in the field. Colonel Harts will be assigned to the command of the Sixth Regiment of Engineers, recently organized, and now stationed at Washington Barracks, awaiting orders to proceed to France.

Major Ridley was graduated from West Point in 1905. After service in Honolulu, the Philippines and elsewhere, Major Ridley was assigned to duty in connection with river and harbor improvements in the vicinity of Wilmington, N. C., and remained on that station until the fall of 1916, when he was summoned to Washington for duty as an assistant to the Chief of Engineers.

Since the outbreak of the war with Germany he has acted as an assistant to Col. E. Eveleth Winslow, in charge of the military division of the engineer bureau, and was in immediate charge of the personnel of the Engineer Officers' Reserve Corps. Under the law, as the officer in charge of public buildings and grounds, Major Ridley will have the rank, pay and allowances of a colonel of engineers.

Admiral Capps Gives Progress of Shipbuilding Program

Rear Admiral Capps, chairman of the Emergency Fleet Corporation, has issued the following statement, dated Sept. 27:

During the past two months the Emergency Fleet Corporation has awarded contracts for 118 wooden vessels of 3500 tons dead-weight capacity each to 27 different shipyards. There had previously been awarded contracts for 235 wooden vessels of similar type to the above and for 58 vessels of composite construction.

During the past two months the designs for machinery have been completed for the manufacture of engines, boilers and other articles of equipment for these vessels, for which the facilities available of machine shops and boiler works throughout the country have been availed of.

Great difficulty has been experienced on the Atlantic Coast in obtaining suitable lumber for these ships, and it is anticipated that there will be greater delay in their completion than was expected when this movement was begun.

Since Aug. 1 there has been awarded contracts for 155 steel cargo vessels of 1,076,800 tons dead-weight tonnage, distributed among six shipyards. The most important of these contracts are for vessels of the so-called fabricated type, and special shipyards are being prepared for them. Contracts for the boilers and machinery and steel construction of these vessels have already been placed.

In addition to the above Congress has a pending bill is authorizing the construction of additional vessels whose total dead-weight capacity will be nearly 5,000,000 tons. Plans for the major portion of these additional vessels are now in course of preparation and many of them will be of special types adapted to particular necessities of war, and while substantially cargo carriers will have much greater speed than the cargo vessels now under construction.

New Safety Record on Building Construction Made

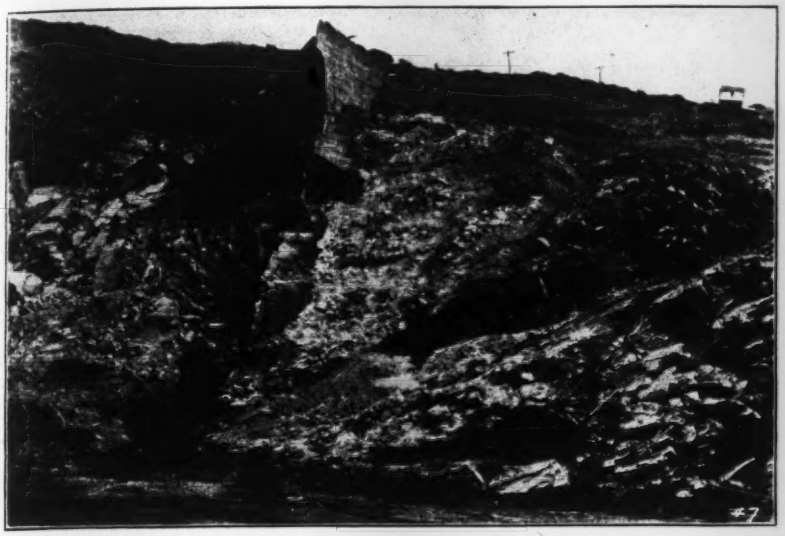
The California State Industrial Accident Commission makes the claim that a new national record for safeguarding workmen was established on the construction of the new Southern Pacific Building in San Francisco, the largest office building west of Chicago. The Commission was represented personally during the construction period by J. J. Rosenthal, now a captain in the United States Engineer Corps, and while work was rushed, not a single fatality nor even a serious accident was registered. At one time excavating, pile driving, the pouring of concrete and the erection of the steel framework was under way.

Forest Products Laboratory Makes Appeal for Men

The Forest Products Laboratory at Madison, Wis., is engaged in experimental and research work dealing with wood, especially at the present time in its application to the construction of airplanes for military purposes, and recent advices indicate that this work requires more men having an engineering or chemical training than are at present on the staff of the laboratory. Those who feel qualified to undertake work of this nature should notify the director at the address above indicated, and let him know of their qualifications and willingness.

Company Must Continue Free Fire Hydrant Service

Free water for fire protection and sprinkling must be continued by the local water company supplying Sandpoint, Idaho, according to a decision of a district court. The company's franchise, granted in 1905, provides for free water from as many fire hydrants as the city sees fit to install, as well as free water for sprinkling. In 1915 the Idaho Public Utilities Commission ordered the city to sell the company all fire hydrants and to pay the company $314 a month for public service. The court holds that the franchise has a contract that cannot be set aside by the commission and that the hydrants are the property of all taxpayers of Sandpoint. The suit to set aside the order of the commission was brought by the city.



PRESENT CONDITION OF LOWER OTAY DAM

Large Earth-Moving and Concrete Job on Columbus Channel

The Columbus (Ohio) channel improvement work is nearly ready for bids. The major part of the work is earth excavation and fill, amounting to about 2,000,000 cu.yd. However, there is an arch highway bridge, a concrete overflow dam 20 ft. high by some 600 ft. long, a reinforced-concrete levee wall 24 ft. high and 1200 ft. long to act as emergency spillway, and a considerable yardage of monolithic reinforced-concrete revetment slab.

The entire work is to be let as one contract, on account of the unavoidable interferences between the separate items. Bids will be asked on a straight unit-price basis, according to present intentions. However, the city laws permit the cost-plus contracts, provided a fixed maximum cost is set, and this method of bidding may be considered.

The excavation is channel widening exclusively. The work extends over a length of about 2 miles, and represents a depth of cut averaging 20 ft., by several hundred feet wide. No rock is encountered. The new channel side must be trimmed to an even slope, and grassed.

The excavation spoil is required to be used in part for building levee embankments along both sides of the channel. About half the total excavation, however, must be moved downstream to form levees along a 2-mile stretch below the widened section. All levees will have a top width of 80 ft. minimum (with local exceptions) and must be trimmed and grassed.

The one bridge forming part of the contract, at Town St., comprises seven arches, 78 to 105 ft. in span, with deck 60 ft. wide over all.

The entire work is in the Scioto River, between the mouth of the Olentangy and the sewage pumping station—a distance of about 4 miles. River conditions involve very low flow from April to cold weather, with the risk of occasional summer flood up to 20,000 cu.ft. per second. Winter and spring floods may range normally up to 35,000 cu.ft. per sec. and under the exceptional conditions of the 1913 flood up to 140,000 cu.ft. per second. The present channel has a discharge capacity up to levee tops of about 60,000 cu.ft. per second.

Requirements as to time of completion will probably not be specified. All reinforcing steel will be furnished by the city, delivery being expected shortly. The sand and gravel for concrete can be largely obtained from the river bed.

The enterprise is under charge of George A. Borden, Director of Public Service of Columbus. Henry Maetzel is Chief Engineer of the Department. R. H. Simpson is in charge of the channel improvement. Estimates made one year ago fixed the probable cost of construction (not including real estate) at $1,750,000, but about $2,000,000 will be available.

Urges Arbor Day Tree Planting Along Pennsylvania Roads

Planting trees along Pennsylvania roads on "Fall Arbor Day," Oct. 26, is being promoted by J. Denny O'Neil, state highway commissioner. He has sent a letter to county engineers and superintendents instructing them to have caretakers and foremen on the various state roads and endeavor to interest abutters in tree planting. In view of his belief that roads will be widened in the future, especially at curves, Mr. O'Neil advises that trees should not be planted more than a foot outside the fence line. He suggests the use of fruit trees, and names the ox-heart cherry as a highly ornamental tree, giving both shade and fruit. Apple trees are also suggested or low flat-headed trees, with pruning to produce a high conical top as desired. For purely shade purposes Mr. O'Neil would select the sugar maple or red oak.

Lower Otay Dam To Be Rebuilt Without Delay

After the City Council of San Diego had awarded the Wurster Construction Co. the contract for rebuilding the lower Otay dam for $420,000, the Wurster Company refused to accept on these terms, claiming they had made an error of $1 in figuring the cost of excavation. Instead of bidding $1.55 per cu.yd. the contract read 55c. The size of the contract was such that this amounted in total to a difference of $95,000 in the bid.

The City Council refusing to allow the Wurster Co. to make a change in their bid, the Wurster Co. forfeited their certified check, and in spite of a temporary injunction which was gotten out to enjoin the City Council from awarding the contract to any other contractor than the Wurster Co., on Sept. 22 the Council awarded it to James Kennedy at $505,000. The Kennedy bid was originally $586,736, but this, it was stated, had been agreed to be reduced to the lower figure in consideration of some changes being made in the plans and specifications.

At the same time the bid of the Southern California Portland Co. was accepted, under which the city will secure 85,000 bbl. of cement for this work, at a price of $2.03 per bbl.

Headings Meet in Wilson Avenue Tunnel, Chicago

The lake section of the Wilson Ave. water-intake tunnel at Chicago was holed through on Sept. 11. This section of the tunnel is three miles long, with a land extension of five miles to the new pumping station. It is 12 ft. diameter. The drift from the shore shaft is of very exceptional length, 14,848.8 ft.; the drift from the crib or intake shaft was 1054.2 ft. long. The connection was true, with an error of only 17 in. in theoretical line and 0.1 ft. in grade. The sinking of the shore shaft was commenced Aug. 15, 1913. Authority to drive the heading was given on Sept. 1, 1914, this part of the work being done by day labor. The crib shaft and drift were built by contract. On the shore end of the tunnel (also done by day labor) up to Sept. 11 the length excavated was 27,388 ft. and of this 23,068 ft. had been lined. The work is under the direction of John Ericson, City Engineer; H. W. Clausen is in direct charge as engineer of waterworks construction. The survey work for this long tunnel was described in *Engineering News-Record* of July 26.

Oregon Road Commission May Work Men More Than 8 Hours

The State Highway Commission, of Oregon, has power to declare that an emergency exists in road construction and to work its employees more than eight hours a day to meet the emergency, according to an opinion written by Attorney-General Brown, at the request of State Labor Commissioner O. P. Hoff.

Two Lawyers and Publicity Man for Commerce Commission

Lawyers, in the persons of Clyde B. Aitchison and George W. Anderson, have been nominated by President Wilson for two of the three vacancies in the Interstate Commerce Commission caused by the death of Judson C. Clements, and the enlargement of the commission to nine members. The third appointee is Robert W. Woolley, newspaper and publicity man, and in recent years director of the Mint.

Robert W. Woolley, nominated for the term ending Dec. 31, 1920, is a native of Kentucky and is 46 years old. His early years were spent in newspaper work. In 1911-12 he was chief investigator for the Stanley Committee, which examined the affairs of the U. S. Steel Corporation. In 1912 he was chief of the publicity bureau of the Democratic National Committee. In 1913 he was made auditor of the treasury for the Department of the Interior, and in 1915 became director of the Mint. His latest notable activity was as publicity director for the first Liberty Loan campaign.

Clyde B. Aitchison has been for the last year and a half solicitor for the National Board of State Railroad Commissioners, in which capacity he has represented the board in the various valuation discussions before the Interstate Commerce Commission arising from the federal valuation of the railroads. Before that he was chairman of the Public Service Commission of Oregon, of which he was appointed a member in 1907. Prior to that he was secretary of the Oregon Tax Commission appointed to redraft the state tax laws.

George W. Anderson has been United States district attorney at Boston for the last three years. He is a native of New Hampshire and is 56 years old. He began practicing law in 1890, after being graduated from Williams College and Boston University Law School. In 1913 he was appointed a member of the Massachusetts Public Service Commission, but the following year he resigned to become United States district attorney.

Both Mr. Aitchison and Mr. Anderson are in wide disagreement with the railroads as to the governing principles of valuation. Mr. Aitchison as spokesman for the National Board of State Commissioners, and before that as member of the Oregon Commission, has opposed before the Interstate Commerce Commission most of the contentions made by the railroads in connection with the federal valuation. The title of an address, "How To Get Rid of the Reproduction-Cost Theory," read two years ago at the valuation conference, held by the Utilities Bureau, plainly suggests Mr. Anderson's attitude; while he is further known to valuation engineers for his violent attacks on one of the earliest large railroad valuations, made by one of our most eminent engineers. The predilections of Mr. Woolley, if they exist, have not been revealed.

Cleveland Will Add Public Hall to Group Plan

With the breaking of ground recently for the new public hall, Cleveland takes another step toward the realization of its group plan. Of the buildings in the group plan, the federal building, court house and city hall have been completed, and bonds have been voted and site cleared for the public library. Plans for the new union station were nearing completion when the onset of the war held them in abeyance. A bond issue of $2,500,000 for the public hall was authorized by the voters about a year ago, but on account of increase in prices of all elements of building, the funds in hand will only provide for the completion of the main auditorium and exposition section which will seat 12,000 people. The music hall section and section that will include small halls for public meetings will have to be delayed. The public hall will be bounded by E. 6th St., St. Clair Ave., Lakeside Ave. and E. 4th St.

Municipal Coal Mine To Be Opened by Pittsburgh

Bids are about to be asked for construction of a shaft and manway and for installation of machinery for a coal mine on the Marshalsea Poor Farm of Pittsburgh, Penn. The project calls for developing a capacity of 500 to 700 tons per day. A cost of $90,000 to $100,000 is estimated, of which about $13,000 is for the 60-ft. air shaft and the 140-ft. stope.

The enterprise is the sequel to very serious conditions that the city water department had to wrestle with last winter. The coal supply was so uncertain that shutdowns were threatened several times, and as it was there were occasions when single pumping units were shut down for periods of several hours in order to make the remaining coal last until a new supply came in. The city had a contract, at a price however which under last winter's conditions was very unattractive to the seller. Moreover, the railway congestion made all car movements uncertain. Prices up to $4 or even $5 per ton were paid for some supplementary coal supplies, as against the contract price of $1.60.

A further difficulty was the inability of the city to get labor, both that needed for unloading coal from boxcars (gondola cars being used elsewhere by the railroads) and labor required for filter-sand cleaning. Assistance was given by a contractor, who furnished men from his construction gangs. The labor difficulties of the water department are still serious, and a sufficient number of laborers is not obtainable.

While these factors led to the coal mining project, the latter is not likely to help out during the coming winter. The best proposals for furnishing the mining machinery and cars make it likely that 7 to 9 months will be needed after letting contracts before the mine can be operating. When operated at full capacity, however, a product[ion] cost of $1.10 to $1.50 per ton is anticipated.

The proposed mine will top the Pittsburgh seam, 5½ ft. thick, which should produce 7000 tons per acre. About [200] acres of coal on the farm can be mined.

New Industries Will Use Improved Lake Calumet Harbor

The river and harbor committee of the Chicago City Council is considering plans for the improvement of Lake Calumet, which has been deeded to the city by the State Legislature. The lake is not navigable at present, but the city plans to dredge about 500 acres for a deep-water harbor. The dredged material would be used to reclaim about 2000 acres of low land adjacent to this harbor, forming a good site for industrial and manufacturing plants. The lake is connected with Lake Michigan by the Calumet River, which will have a channel 22 to 25 ft. deep. A number of large industries are included in this territory and it is stated that new construction work amounting to $13,000,000 is contemplated, including the new shops of the Pullman Company.

Canada Seeks To Use Niagara Power Now Sent to This Country

Sir Henry Drayton, chairman of the Canadian Board of Railway Commissions, has been appointed by the Canadian Government as Commissioner to investigate the exportation into the United States of electric power generated at Niagara Falls, Ont. It will be recalled that in this connection Sir Adam Beck, chairman of the Provincial Hydro-Electric Commission, recently stated at a convention of the Union of Canadian Municipalities that the demand for hydro-electric power was increasing so rapidly in the Niagara zone that more than 83,000 additional horsepower would be required in a very short time. The commission, he said, was prepared to take proceedings to expropriate power from the Canadian Niagara Power Co. and the Electric Development Co., developing power at the Falls, of which 140,000 hp. is now exported to the American side which should be conserved for use in Canada. The commission has been granted the power to expropriate the electricity generated by these companies by an order-in-council recently passed by the Ontario Government.

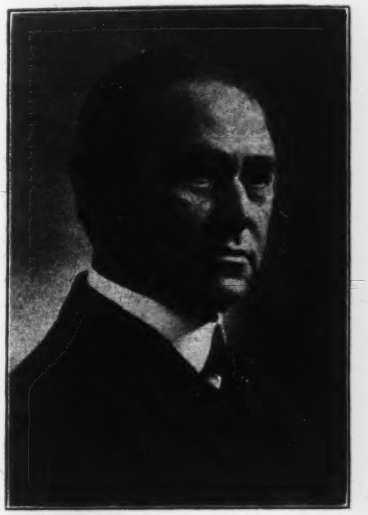
Columbia River Highway Located

The route has been selected by the Oregon State Highway Commission for the Columbia River Highway, from Hood River to The Dalles. The length of the route is 10.7 miles. The maximum elevation of the river route is 107 feet, as compared with 1107 feet on the Hill route. The new work in Hood River County will be the most difficult construction work to be undertaken anywhere in the state by the highway department this year. The department contemplates expending $500,000.

PERSONAL NOTES

EDGAR S. NETHERCUT, who was elected secretary of the Western Society of Engineers, Sept. 10, is expected to inject new energy into the administration of its business. His election fills the vacancy left by the resignation of E. N. Layfield some months ago. Mr. Nethercut was born

New Secretary for the Western Society of Engineers



EDGAR S. NETHERCUT

at Lake Geneva, Wis., in 1866. He graduated from the University of Wisconsin in 1889, and then began his career as a draftsman with Wade & Purdy. From 1893 to 1907 he was chief engineer of the Paige Iron Works and the Buda Co. For the next four years he was engaged on track valuation, at first for the Public Service Commission of New York (First District) and then for the Detroit United Ry. From 1911 to 1914 he practiced as a consulting engineer in Chicago, and in 1914-17 was in charge of the valuation of track and rolling stock of the Washington Railway and Electric Co. at Washington, D. C. This valuation amounted to over $100,000,000.

Mr. Nethercut is a member of the American Society of Civil Engineers and the Western Society of Engineers. He belongs to the Chicago Engineers Club, the Engineers Club of New York and the University Clubs of Chicago and Washington.

F. R. DEMAREST, who was connected with the engineering staff of the Turner Construction Co., New York City, is at present in direct supervision of all railroads and concrete roads in connection with the Aviation Experimental Station at Langley field, Hampton, Va., under the direction of CAPT. JOHN SLOAN.

C. MANNING, who has been in the service of the Grand Trunk Ry. for over 30 years, has been appointed vice president in charge of motive power, car equipment and machinery.

A. W. MCLIMONT has been appointed general manager of the Winnipeg Electric Railway Co., vice WILFORD PHILLIPS, who retires on account of poor health. Mr. McLimont was at one time engaged as engineer with the New York Public Service Commission, and was subsequently retained as engineer in connection with the rehabilitation of the Chicago & Milwaukee Electric Ry. He has lately been in control of the Michigan United Railway System.

ROBERT W. DAVIS, who has been road engineer of Fayette County, Kentucky, for the past four years, recently tendered his resignation to the fiscal court on account of the interferences of other county officials in the supervision of the asphalt plant. Mr. Davis' resignation was accepted.

CHARLES ASH, who for the past year has been in charge of surveys and has assisted in perfecting plans for flood control of the upper Scioto River, has been appointed deputy county surveyor of Marion County, Ohio, and has charge of the surveyor's office during the absence of LORING K. WARNER, who has received a commission as first lieutenant and is stationed at Fort Leavenworth training camp.

RAYMOND BAFFREY, president of the Hennebique Construction Co., has returned from France on a furlough. He is a captain in the French army and has been in the service since the beginning of the war, being recently painfully wounded, but has now fully recovered.

ARTHUR N. DUNAWAY, chief draftsman for the Chicago Sanitary District from 1906 to 1915, and for the succeeding year in private practice as a drainage engineer, with headquarters at Elbow Lake, Minn., is now captain in Company C, 12th Railway Engineers.

ENGINEER COLONELS ASSIGNED TO REGIMENTS

Col. Sherwood A. Cheney, Engineers, National Army, is assigned to the One Hundred and Tenth Engineers and will proceed without delay to Camp Doniphan, Fort Sill, Okla., and report to the commanding general, Thirty-fifth Division, for duty with the regiment to which he is assigned.

Col. Edward H. Schulz, Engineers, National Army, is assigned to the One Hundred and Ninth Engineers. He is relieved from station at St. Paul, Minn., and will proceed without delay to Camp Cody, Deming, N. M., and report to the commanding general, Thirty-fourth Division, for duty with the regiment to which he is assigned.

Col. Paul S. Bond, Engineers, National Army, is relieved from station and duty at Cleveland, Ohio; is assigned to the One Hundred and Seventh Engineers; and will proceed without delay to Camp MacArthur, Waco, Tex., and report to the commanding general, Thirty-second Division, for duty with the regiment to which he is assigned.

Col. John C. Oakes, Engineers, National Army, is relieved from station and duty at Philadelphia, Penn.; is assigned to the One Hundred and Thirteenth Engineers; and will proceed without delay to Camp Shelby, Hattiesburg, Miss., and report to the commanding general, Thirty-eighth Division, for duty with the regiment to which he is assigned.

Col. Michael J. McDonough, Engineers, National Army, is relieved from duty at Plattsburg Barracks, N. Y.; is assigned to the One Hundred and Fourteenth Engineers; and will proceed without delay to Camp Beauregard, Alexandria, La., and report to the commanding general, Thirty-ninth Division, for duty with the regiment to which he is assigned.

Col. Frank C. Boggs, Engineers, National Army, is assigned to the Three Hundred and Fifteenth Engineers. He is relieved from duty as department engineer, Southern Department, and will proceed without delay to Camp Travis, Fort Sam Houston, Tex., and report to the commanding general, Ninetieth Division, for duty with the regiment to which he is assigned.

Col. George B. Pillsbury, Engineers, National Army, is assigned to the One Hundred and Fifteenth Engineers. He is relieved from duty at the training camp, Presidio of San Francisco, Calif., and will proceed without delay to Camp Kearny, Linda Vista, Calif., and report to the commanding general, Fortieth Division.

Col. Curtis W. Otwell, Engineers, National Army, is relieved from station and duty at Philadelphia, Penn.; is assigned to the One Hundred and Fourth Engineers, and will proceed without delay to Camp McClellan, Anniston, Ala., and report to the commanding general, Twenty-ninth Division, for duty with the regiment to which he is assigned.

Col. Harley B. Ferguson, Engineers, National Army, is relieved from station and duty at Boston, Mass.; is assigned to the One Hundred and Fifth Engineers, and will proceed without delay to Camp Sevier, Greenville, S. C., and report to the commanding general, Thirtieth Division, for duty with the regiment to which he is assigned.

Col. Lytle Brown, Engineers, National Army, is relieved from duty at the training camp, Fort McPherson, Ga.; is assigned to the One Hundred and Sixth Engineers, and will proceed without delay to Camp Wheeler, Macon, Ga., and report to the commanding general, Thirty-first Division, for duty with the regiment to which he is assigned.

GEORGE S. EATON has resigned as assistant professor of civil engineering at Clemson Agricultural College, S. C., and has taken up work in the pavement division of the promotion and and inspection bureau, Universal Portland Cement Co., Chicago.

BUSINESS NEWS

Joint Waterway Freight Line for New York State

Announcement has just been made of a traffic arrangement between companies operating freight lines on the Great Lakes, the New York State Barge Canal and the Hudson River whereby through all-water freight service is established between New York City and Western Lake ports. The companies involved are the Catskill & New York Steamship Co., operating on the Hudson; the Shippers' Navigation Co., operating on the canal, and the Great Lakes Transit Co., operating on the Lakes. The new route will operate as the Hudson-Great Lakes Despatch and will handle carload or less than carload lots at rates substantially lower than rail rates as far west as St. Paul, the latter destination being reached by rail. For the present the New York State Barge Canal will be utilized from Troy to Oswego, but in the coming season the through Troy-Buffalo route of the canal is expected to be put in service.

Let Contract for Record Gas-Pipe Line

A contract for what is said to be the largest gas-pipe line in the country is one of two just awarded by the Carnegie Steel Co. to the T. A. Gillespie Co., of New York and Pittsburgh. The contractor is to manufacture the 40-in. lock bar steel pipe and construct the 10 miles of line by January next. The second contract is for 5 miles of heavy railroad construction. Both are in connection with the new byproducts coke plant of the Carnegie Steel Co., at Clairton, Pennsylvania.

The pipe line will carry gas from Clairton to the Duquesne and Edgar Thompson steel plants of the Carnegie company, where it will be used for fuel. Work on this line is being rushed because the supply of natural gas in the Pittsburgh district, which is giving out, is at a minimum in the winter months.

The railroad, which will parallel the pipe line for a considerable distance, will connect the Clairton plant with Bull's Run, on the Union R.R., 5 miles distant. The James A. Hart Co. is associated with the T. A. Gillespie Co. on this contract. The railroad work will include 1,200,000 yd. of grading and about 75,000 yd. of concrete, largely in arch bridges. The construction of a 1700-ft. double-track tunnel is required. It is expected that the railroad will be completed by Jan. 1, 1919.

Several trainloads of pipe and construction plant will be required for both contracts, which amount in all to about $4,000,000.

Test Truck Motors with Frame Twisted

One of the road tests for United States motor truck chassis, shown in the photograph, consists in running the truck into a position where one wheel is several inches above the plane of the other three, to make sure that this twisting will not affect the starting or running of the motor. The twisting

STOP CAR WITH FRAME IN TWISTED POSITION TO MAKE SURE ENGINE WILL START

of the frame to this extent is not calculated to interfere with the running of the motor through exerting pressure on the bearings, as the "floating" power plant mounting is designed to eliminate this difficulty.

Building the Government Merchant Ships

It is probable that 200 steel ships of uniform design from 5000 to 9000 tons deadweight each will be built for the United States Government by three concerns, to whom contracts for 50 such vessels were recently let by the United States Shipping Board Emergency Fleet Corporation. The actual number of ships to be built will be decided by the Government within 60 days from date of contract. The steel for the vessels will be fabricated in different mills throughout the country and shipped to three assembling plants. The Merchants Steamship Corporation will erect 9000-ton ships at a plant at Bristol, Penn. The New York Shipbuilding Corporation (the American International Corporation) will assemble 7000- to 7500-ton boats at Hogg Island, near Philadelphia. The 5000-ton vessels will be assembled at a plant now building on the Newark Meadows, N. J., for the Submarine Boat Company.

As these three concerns will handle their contracts in the same general manner, only one of them need be considered. The Submarine Boat Co. expects to have its Newark shipways ready to operate in November or December of this year. Twenty-eight ships will be assembled at a time, and each batch should be finished in four months.

All pumping equipment is being furnished by the Worthington corporation. Motors, dynamos and electrical apparatus by the Westinghouse Electric and Manufacturing Co. The machine-tool requirements of the three ship-assembling concerns will probably be nominal. The requirements for machine tools to handle these contracts will be restricted almost entirely to such additions as may be necessary in the existing fabricating mills.

New Standard Army Truck Will Be Made in Two Models

The designing of the new standard military truck has been completed. A sample chassis will be ready by the middle of October. Deliveries are expected to begin in January, within four months after the War Department undertook the development of the truck.

Early in August about 50 truck specialists and engineers of established reputation came to Washington at the invitation of the Quartermaster Corps. The Society of Automotive Engineers also sponsored the Washington conferences. Both manufacturers and engineers generously contributed trade secrets in the designing of the military truck, just as they did in the development of the aviation engine.

After a series of conferences the design of the standard truck was completed early in September. Within 10 days detailed drawings were made and sample parts ordered. Ordinarily it requires several months to perfect and turn out such parts, but various manufacturers patriotically agreed to put ahead the Government's work and delivery of the parts, it is now expected, will be made by Oct. 1.

The new military truck will be made in two models, class A and class B. The engine used in the two will be the same in design, except for slight differences in cylinder bore, pistons, piston parts and riggings. To a large degree interchangeability of parts will be possible. The class A model will have a normal carrying capacity, under the arbitrary official ruling, of 1½ tons, with an actual commercial capacity of 3 tons. The class B truck will have a normal capacity of 3 tons and an actual capacity of 5 tons. Both trucks will have a two-wheel drive, with a speed requirement of 14 miles per hour for the class A trucks and 12 miles for class B trucks.

It is planned that the first orders for the trucks shall call for 10,000 vehicles, to be delivered in the first six months of 1918. These orders will call for 10,000 class B and 5000 class A trucks. The adaptability of the new trucks to commercial as well as military uses is indicated by arrangements now being made by a number of manufacturers to produce them for commercial purposes.